

B (not for Competition)

CASES ILLUSTRATING SOME POINTS IN
THE DIAGNOSIS AND TREATMENT OF DIPHTHERIA.

A Record of 143 Cases.

Being a Thesis for the Degree of M.D., Edinburgh,

by

C H A R L E S P O R T E R ,

M.B., C.M., 1896.



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I N T R O D U C T I O N .

When the memoirs of Bretonneau were published in 1825 much of the uncertainty which had existed with regard to Diphtheria was cleared away.

Recognising that the disease was a definite one and distinct from other inflammatory affections of the throat and recognising also that the disease known as croup was due to a condition practically the same, he proposed to drop all other names and call it Diphtherite. Later his pupil Trousseau modified the word to Diphtherie whence Diphtheria.

In reviewing the history of Diphtheria Bretonneau⁽¹⁾ quotes from the works of Aretaeus and Hippocrates to prove that the disease was known in their day.

Aesclepiades, 100 B.C. had also met cases and had recommended laryngotomy in laryngeal diphtheria.

Aetius in the 6th century mentions a disease in which there was the formation of a false membrane and points out the danger of tearing this away.

Later, in the 16th and 17th Centuries the subject/

ject was worked at by many observers in most European countries.

After the death of Washington in America, as well as after that of Napoleon's nephew, Louis, a great deal of study was given to the causation and arrest of the disease and for Napoleon's prize, 83 memoirs were sent in. Of the essays, those of Jurine of Geneva and Albers of Bremen were considered best and the prize was divided. Referring to these, Lennox Browne says that:- "The methods of treatment and the opinions enunciated by these authors, forcibly demonstrate the great lack of information which obtained at that time."

In spite of all this, however, Bretonneau is the observer to whom we owe most, and his five memoirs are full of the most interesting details. Most of his observations were made during an epidemic in Tours, Chenusson and La Ferriere which lasted a considerable time and caused the loss of a great many lives.

He describes all the symptoms of diphtheria with great exactness and instances numerous cases of the laryngeal, faucial, and nasal forms, the last very frequently following influenza and especially liable, he states, to be followed by paralysis.

Guersant/

Guersant, Trousseau, Bouchut and others at the same time described carefully the clinical features of the disease.

As before, so since their time, many have been attracted to the study of Diphtheria; Virchow, Von Graefe, Jenner, Morrell-Mackenzie, Oertel, and very many famous workers are in the list, but it was reserved for Klebs in 1883 to describe the bacillus and for Löffler to work out the cultural characteristics of the organism now called the Klebs-Löffler Bacillus.

Roux and Yersin and Klein confirmed the observations and bacteriology, coming thus to the clinicians aid, made diagnosis more easy and accurate and cases wrongly considered diphtheria began to get sorted out.

The next important step in the history of the disease and possibly the most important - no mention is made of the work of Sanitarians in connection with the causation and prevention of diphtheria - was the announcement by Behring and Kitasato in 1890 that they had succeeded in immunizing healthy animals so that they had become incapable of contracting diphtheria.

In 1893 treatment by antitoxic or immunised serum/

serum was begun, and though by many the treatment is said still to be on its trial, it has grown steadily in favour and may now be said to be the only treatment of the disease.

The most recent work on Diphtheria concerns itself mainly with the prevention of the disease by the administration of prophylactic doses of the serum to persons exposed to infection, a means which is meeting with a considerable amount of success.

OBJECT AND SCOPE OF PRESENT ESSAY.

Working off and on in fever hospitals since 1897 and for the last two years acting in charge of such institutions here and elsewhere, one has had numerous opportunities of seeing the various forms of diphtheria, and with the hope of learning how far it is possible to make an accurate diagnosis from the clinical features alone, one has chosen a series of 100 cases in which the disease was limited to the upper air passages and 43 - to be first considered - in which the larynx was involved.

The value of bacteriology one does not for a moment doubt and indeed practically in every case a bacteriological examination was made, but the cases/

the cases notified for removal to hospital are, with few exceptions, diagnosed from the clinical signs alone.

The difficulty of making a diagnosis from the clinical features is considerable, more especially outside hospital practice, mainly because in many cases a thorough examination is impossible. In hospital a medical man has practically no disadvantages to contend with. He has light, and he has liberty to go into every particular, both of which are often withheld from those outside.

P A R T I .

LARYNGEAL DIPHTHERIA:

The variety of cases notified and admitted to Infectious Diseases' Hospitals as Croup or as Laryngeal Diphtheria is sufficient evidence of the difficulty attending the diagnosis of the disease.

Measles in the pre-eruptive stage, and Pertussis, before the characteristic cough has appeared, capillary bronchitis and tonsillitis are some of the diseases to which the name Croup is given, and, though it is helpful, from the Public Health point of view, to have all doubtful cases isolated, those who are thus sent amongst patients with diphtheria are, - preventive injections of antitoxin notwithstanding - exposed to a certain amount of risk.

In very many cases the difficulty of making a diagnosis is due to the absence of a clear idea of what Croup really is, and for this, Bretonneau⁽¹⁾ blames Francis Home, who introduced the word and described as a new disease what, for long, had been regarded as a symptom.

At first used as a clinical term, the word later acquired a pathological significance and as a result, much confusion and uncertainty arose, which apparently/

apparently. up to the present time have not been dissipated.

In 1879 the Royal Medical and Chirurgical Society appointed a "Committee on Membranous Croup and Diphtheria", which committee, after considering the matter, suggested. "That the term Croup be henceforth used wholly as a clinical definition implying obstruction laryngeal occurring with febrile symptoms in children." This did not apparently have any great effect for the books still continued to consider Croup as a respiratory disease, and to give diphtheria as one of its causes. Practitioners also certified deaths as due to Croup and in the Registrar General's returns, Diphtheria was classified with the Miasmatic Diseases and Croup with diseases of the Respiratory System.

Obviously recognising this uncertainty in the nomenclature, the Infectious Diseases Notification Act of 1889 calls for the notification of Membranous Croup as well as of Diphtheria.

In the more recent text-books of Medicine and in treatises on Diphtheria, there is still evidence of difference of opinion. Dr Gee in Albutt's System talks of Catarrhal Croup, Spasmodic Croup and Diphtheritic Croup, while Lennox Browne⁽²⁾ wishes to/

to define Croup as, "A pseudo-membranous exudation of the larynx and trachea". Osler⁽³⁾ states that membranous croup may be either genuine diphtheria or diphtheroid in character, the former being determined by the presence of the Klebs Löffler bacillus, the membrane in the latter being produced by other organisms.

Apparently, there are still the two classes; those who wish the word croup retained as a synonym for Diphtheria of the larynx and those who wish to use it only as descriptive of the symptoms produced by laryngeal obstruction irrespective of the cause.

A definition of Croup given by Goodall and Washbourn⁽⁴⁾ who belong to the latter group, is a very comprehensive and helpful one. They state that, "Croup is obstruction of the air passage, at or about the larynx, giving rise to dyspnoea, and the obstruction may be due to more than one cause, the presence of membrane, a foreign body and so on."

Judging from the cases admitted to hospital notified as "Membranous Croup" or as "Croup", it would almost seem that the majority of practitioners adhere to the first view, although, in many instances, the obstruction to the breathing being due to/

to enlargement of the tonsils or some such condition, is not croup at all.

In these cases, one cannot help feeling that it would be very much better if croup were regarded as describing a symptom only, for it would almost appear that, the observer finding obstruction to the breathing, at once names it croup and then goes no further for a diagnosis because croup is laryngeal diphtheria. If the second view were the one generally accepted obstruction to the breathing or croup being found, the observer bearing in mind that such, far from being a disease, was merely a symptom, would, if he desired to make a correct diagnosis, be forced to continue his observations till the condition causing the croup was found.

During the past two years, one has had an opportunity of observing croup due to a variety of causes, In 43 instances, the conclusion arrived at was that it resulted from diphtheria affecting the larynx, and, with the hope of obtaining all possible information from these cases, one determined to analyse them as carefully as possible. The cases in which it was concluded that diphtheria was not the cause, were not less helpful and they are referred to also.

The main object in relating these experiences is/
is/

is in connection with diagnosis and, in arriving at a diagnosis, in addition to observing the clinical features of each case recourse was had, wherever possible, to bacteriology, cultures and films being made from membrane found.

Of the 43 cases seen, 22 were tracheotomized; on 4 occasions no membrane was found in the trachea; in the remaining 18, it was present however, and in 11 of these, an examination was made. One interesting point, already well known, was brought out by the examination of films, viz., the scarcity of organisms in the membrane. In some cases two or more films had to be examined and then only a very few were found.

The bacteriological examination gave the following results:

In one specimen examined, no organisms at all were found; in three a pure culture of Klebs-Löffler bacilli was obtained; in five the bacillus occurred along with cocci and in two only cocci appeared in culture.

In eight (73%) of the eleven cases, therefore, the membrane was probably produced by the *Bacillus Diphtheriae*, but it would be difficult to say that, because one piece of membrane exhibited no bacilli/

bacilli that the other three cases were not due to the action of these organisms.

Lennox Browne, whose definition of croup was given above, divides the condition into,

1. Pure, Simple, or Bacillary Croup.
2. Impure, Complex, or Cocco-bacillary Croup,
3. Pseudo, false or non bacillary Croup.

He quotes also a series of 286 cases examined by Billings in which the membrane was confined to the larynx and bronchi and which was produced in 80%, by the diphtheria bacillus. Osler instances another series of 286 examinations (Park and Beebe) in 229 - 80% - of which Klebs-Löffler bacilli were found.

SYMPTOMS AND DIAGNOSIS:

In arriving at a diagnosis from the clinical features of Laryngeal Diphtheria there is probably nothing which gives more help than the mode of onset of the Croup and the manner in which it proceeds from bad to worse. The following case, which was the first of the series, brings this out well.

CASE 1. Ellen Thomson, age 3, admitted September 14th, 1900.

History.

For some time the child had been out of sorts and on the 9th September, the mother noticed that there/

there were white patches on both tonsils and called in a doctor who prescribed a paint for the throat.

Next day there was no change, but on the 11th September, the voice began to be husky and a cough developed. On the 12th and 13th, the cough continued and there were at times attacks of breathlessness. Poultices were ordered and gave slight relief. During the night of the 13th and the early hours of the morning of 14th September, the breathing became much worse and the cough more frequent and the child was sent to hospital.

On Admission.

The child was fairly quiet. The lips well coloured and, though there were from time to time attacks of coughing and dyspnoea, in the intervals, the recession of the chest wall was not very great. Respiration 24, pulse 160 per minute, fairly good. Tonsils enlarged and coated with exudate. Neck glands enlarged.

Progress.

At 11 a.m., 4500 units of antitoxin were injected under the skin of the abdomen, the child put into a steam tent and a mixture of Sodium Iodide grs. 2 and Vin. Ipecac M. 10 given every four hours. Whisky/

Whisky 3ii and Liq. Strych. Mi every four hours were also ordered. For a time improvement seemed to take place, the attacks of dyspnoea seemed less severe and the child was fairly quiet; about 3 p.m., however, breathing became more laboured, restlessness more marked and cough more frequent and stridulous, and it was determined to follow a more active course of treatment.

An attempt at intubation being unsuccessful, the child was chloroformed and tracheotomy performed; several pieces of membrane were removed and relief was almost immediately obtained. Swabs from the throat and cultures from the membrane, showed typical bacilli and some cocci. The child made a good recovery.

As stated, the history obtained shows well the progressive nature of the Group of Laryngeal Diphtheria. Having once appeared, the symptoms almost inevitably go from bad to worse, unless stopped by the administration of antitoxin, which, given a reasonable time to act, say, 8 - 12 hours, can usually stay the progress of the disease, unless of course, there is so much exudation present that death results from suffocation. In the case detailed it was hoped, by the use of steam, expectorants and/

and stimulants to be able to palliate until the antitoxin had time to act, one saw the child too late, however, and the obstruction had to be removed by tracheotomy.

Another point brought out by this case is, the spread of the infection from the fauces to the larynx and trachea. Judging from one's own experience, one feels safe in saying that, had antitoxin been administered on the day on which the throat was found to be patched, no spread would have taken place, but rather, it is probable, the tonsils would have been free from exudate by the time it was found necessary to perform tracheotomy.

Signs and Symptoms in Detail.

The first sign of involvement of the larynx primary or secondary, is the occurrence of hoarseness and the development of the so-called croupy cough. This may continue for a day or two and then disappear, or else, and more commonly, as a result of increased obstruction, the voice may be reduced to a whisper, the cough become more and more stridulous, and the breathing noisy and interrupted by attacks of dyspnoea, which, unless relieved, may end in death or in the discharge of pieces of membrane.

The/

The course of the disease has been divided into three stages;

- in Stage 1. There is cough and hoarseness,
- Stage 2. Aphonia and paroxysmal dyspnoea,
- Stage 3. Suffocation and asphyxia.

The progress may be checked in the first stage, and fortunately, in those days of antitoxin, this staying of the disease is often seen; out of the 43 cases mentioned, in 13 the laryngeal symptoms got no further than stridor, hoarseness and cough, although in some, slight aphonia was present. Probably this percentage, 32% is low, as it must be remembered that these are hospital statistics and in the great majority of cases, patients are sent in because the symptoms are urgent and the question of tracheotomy has arisen. A series of cases treated outside would, probably, give a much higher percentage. When paroxysms of dyspnoea have become at all marked, recovery rarely occurs under antitoxin and steam, etc.

The onset of the disease is generally gradual. Mothers, one finds, most commonly give a history of the development of a short, dry, cough, which they considered due to a cold, and one has been struck by the frequency with which the information is volunteered that the child has been subject to bronchitis.

With/

With the development of the cough, there is usually associated a certain amount of hoarseness, but, in the majority of instances, though the child possibly is kept indoors, it is able to play about the house. During the night, there may be a little restlessness; the breathing may be a little louder and more rapid than usual and, again, on the next day, the child may be out of bed though less inclined to run about. The following night may pass as the previous one did, but the restlessness may be more marked; the child may be a little feverish and may awake with slight attacks of breathlessness once or twice, which, however, pass off, relieved sometimes by a hot application to the chest.

Next morning, the patient is not so well; the cough is more frequent, more dry, more husky and stridulous, and the voice is gone. The attacks of breathlessness recur, and fomentations or poultices give no relief. During the attacks the face gets dusky, the child pulls at the bed-clothes, tears at its throat, puts its fingers into its mouth in a vain endeavour to get rid of the obstruction, the eyes protrude and are turned from side to side looking for help from the mother, or anyone near. The upper lip, nose and forehead are sprinkled with beads/

beads of perspiration and the skin is cold and clammy. An attack like this may pass off and the child may drop into a sleep from exhaustion. During sleep, the breathing is still laboured and stridulous; the skin is still cold and clammy and the lips dry, dark and bluish. From this sleep the sufferer may awake to an attack worse than the others. The child may stand up in bed straining and struggling, the lower jaw is pulled down and back, the whole chest is moved up; the soft tissues above the clavicles recede, the interspaces sink in, and the lower part of the chest wall is pulled in by the diaphragm. The child may die suddenly in this attack, or may become unconscious and die later asphyxiated. These attacks may be very frequent; some may be worse than others but, nearly always, they become progressively worse.

In the majority of cases under consideration, the symptom which apparently struck the parents of the children was Cough. In other instances, however, the outstanding features would appear to have been hoarseness and difficulty of breathing, and in two adults suffering from diphtheria of the larynx, the first sign was hoarseness, a symptom which preceded the more urgent dyspnoea by nearly 24 hours.

The/

The cough is generally described as "croupy", by which is apparently meant, one which is paroxysmal, frequent, and unaccompanied by expectoration, as the same adjective is applied to the hoarse paroxysmal cough of the early stage of whooping cough.

The description given by qualified observers varies. Guersant says it is, "hoarse, stifled and dry and appears as if going back into the larynx."⁽⁵⁾ There is, at first, a certain amount of voice present in it, but later this tends to go and it becomes more and more toneless and muffled. Expectoration is generally absent, but adults may discharge a forthy mucus. Pain is sometimes complained of by adults, and children not uncommonly hold on to the neck, or rub the upper part of the chest.

The change in the voice usually described as "hoarseness", noticed in younger children when they cry and in those older, when they attempt to speak, was, as stated, in some cases the earliest sign. The voice is whispering, dull, and toneless, but with a somewhat metallic clang in it, and, in speaking, the chin is held high and the patient endeavours to make the neck as long as possible by throwing the head back and pulling on the neck band of the shirt.

During/

During the fits of coughing the face is often noticed to change colour, the skin gets dusky, and the lips dark, and an expression of anxiety is given by the prominence of the eyeballs. This, the tossing about of the head, and the rubbing of the upper part of the chest, struck one as very characteristic.

The attacks of dyspnoea can in many cases only be accounted for by spasm of the glottis resulting from irritation of the mucous membrane - as Jurine, in his prize essay, suggested, for in cases in which the symptoms were severe, and in which tracheotomy had to be hurriedly performed, only small pieces of membrane - sometimes only as large as a threepenny piece - were obtained. Lennox Browne quotes a case in which severe dyspnoea was present with only a thin pellicle of exudate.

In some cases the dyspnoea, as Brétonneau stated, may be the result of occlusion of the air passages by thick membrane. In 10 only of the 43 cases, was sufficient membrane found to suggest that it was the cause of the difficulty.

It appears likely that both causes contribute, spasm being almost certain to result from the irritation of the exudate. The rapidity of the respirations is generally increased between the attacks and attained on the average, between 30 and 40 per minute.

The/

The Pulse in Laryngeal Diphtheria is generally increased in rapidity. In cases of the disease in which stridor, aphonia and indrawing, indicating obstruction, are the outstanding features, attacks of dyspnoea being slight or absent, the heart beats generally above 100 per minute. In two typical cases in this stage, in one, a boy of 8, on admission at 3 p.m., the rate was 120 per minute; at 6 p.m., it had fallen to 104. For the first three days it varied between 96 and 120, on the fourth day, it reached 80, keeping in that neighbourhood till convalescence was completed.

In a girl of three in whom these, the early symptoms were very marked, the rate varied from 130 to 140 during the first 24 hours; on the second day, when all the symptoms had improved under anti-toxin, it fell to 118, and by the fourth day, it was beating at the normal rate.

In cases at a later stage when obstruction is more marked and suffocative attacks are occurring, the pulse still beats rapidly and may be quite good and strong. The pulsus paradoxus sometimes occurs. Of 22 cases sufficiently severe to render tracheotomy necessary, one, a boy of 3, showed this condition; it disappeared immediately the obstruction to respiration was removed.

After/

to show

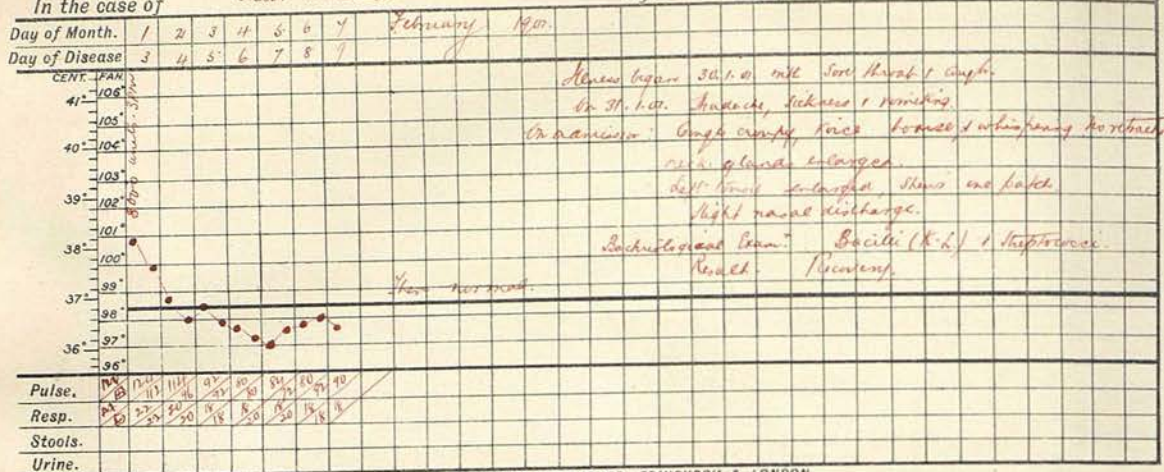
in the early stage of diphtheria, upon admission, 18

Records of Temperature, Pulse, Respiration, Stools and Urine, from

In the case of

Thos. Kenner

Aged 6 Occupation



YOUNG J. PENTLAND, PUBLISHER, EDINBURGH & LONDON.

in a severe case not requiring tracheotomy.

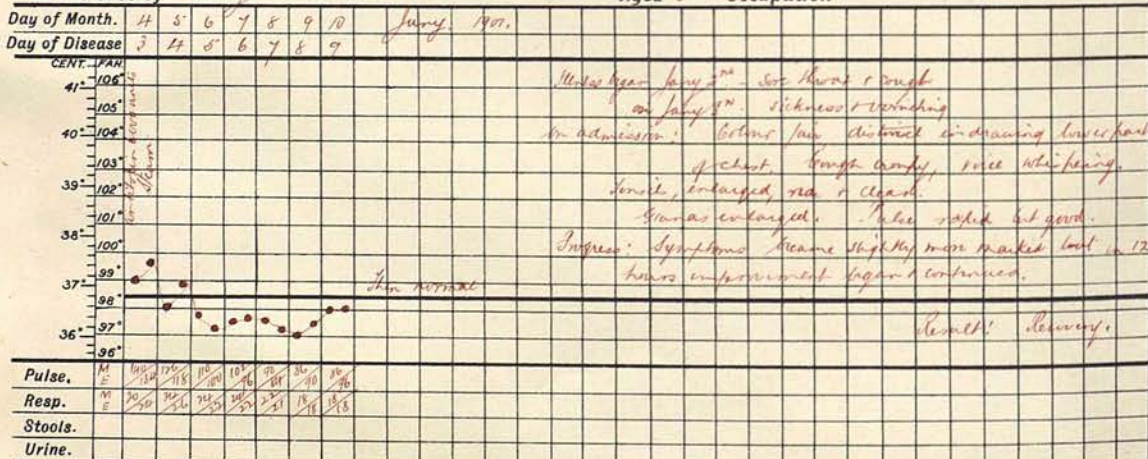
Records of Temperature, Pulse, Respiration, Stools and Urine, from

18

In the case of

Mary Webster

Aged 3 Occupation



YOUNG J. PENTLAND, PUBLISHER, EDINBURGH & LONDON.

After tracheotomy in nearly every case, the pulse and respirations increase in rapidity and continue rapid for a day or two.

Fever in Laryngeal Diphtheria as in all forms of diphtheria, unless complicated by other conditions, rarely reaches any great height. In 20 cases in the first stage of the disease the average temperature was 99° F., the lowest was 97° and the highest 102.4° F.

In the more severe cases the average temperature before tracheotomy was 99.6° F., the lowest again 97° and the highest 102.4° .

The presence of fever may be of some slight assistance in diagnosis and this is probably why the words, "occurring with fever" were introduced into the definition of the Royal Medical and Chirurgical Society. In Laryngismus stridulus, fever is generally absent and in the early stages of measles, if difficulty in diagnosis should arise from the occurrence of laryngeal symptoms, the temperature would in all probability be high.

The temperature in ordinary cases falls by lysis, reaching normal on the third day.

In cases calling for tracheotomy, the course of/

In the case of Alexander Robertson Aged 2 Occupation

Day of Month.	20	21	22	23	24	25	26
Day of Disease	2	3	4	5	6	7	8

CENT.	FAR.
41°	108°
	105°
40°	106°
	103°
39°	102°
	101°
38°	100°
	99°
37°	98°
	97°
36°	96°

Pulse.	110	83	102	110	100	94	80
Resp.	26	24	30	32	28	25	24
Stools.							
Urine.							

of the temperature is interfered with by the operation, rising after it, and continuing up for some days.

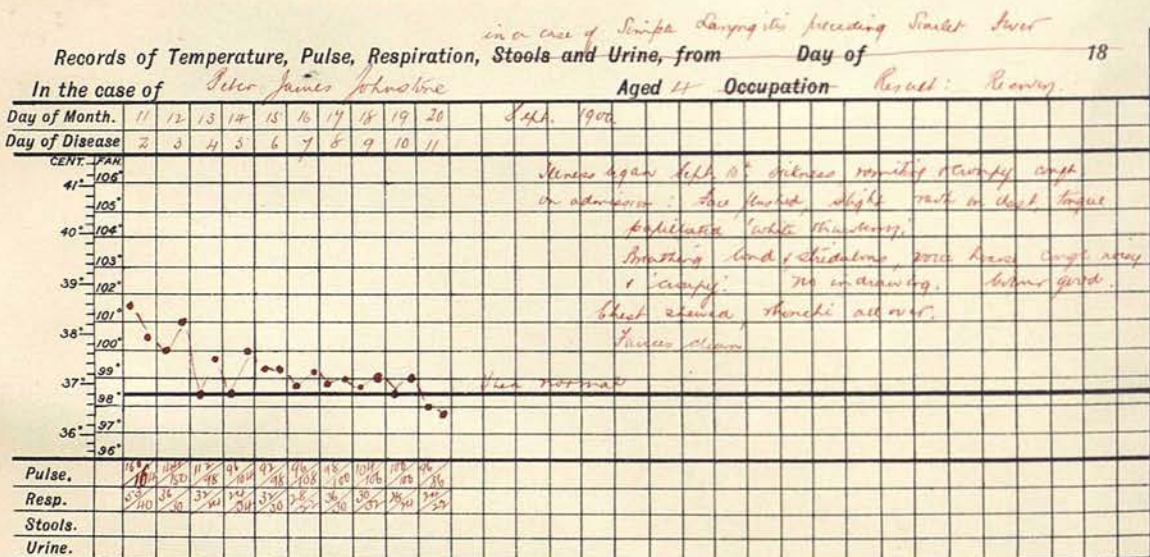
In many cases, however, the temperature may be normal on the 2nd or 3rd day after operation.

In favourable cases, the temperature rarely remains up for more than five or six days. In cases ending fatally soon after operation, the temperature generally falls; in one case, however, a man of 38, 106.6° F. was registered before death.

Complications:

The majority of the complications are, not unnaturally, referred to the respiratory system. Guersant⁽⁶⁾ mentions the occurrence of pseudo membranous gastritis and cites a case in which post mortem examination revealed the presence of the membrane in the stomach. Enteritis and entero-colitis he also mentions. Bronchitis, he met with "pretty frequently" and considers it a favourable complication. He details also, besides mentioning others, a case in which the disease was associated with pulmonary phthisis. The diagnosis was made from the presence of exudation on the fauces and the occurrence of aphonia. Post mortem revealed the presence of membrane in the larynx.

The/



The same writer comments upon the frequency with which pleuro-pneumonia complicates or follows the disease. It must be remembered, however, that the membrane in these may be the result of the action, not of the Diphtheria Bacillus, but of the Pneumococcus. This membrane producing power of the Pneumococcus is well known and reference is made to several instances of it in the Lancet of October 19th, 1901.

Of the diseases with which laryngeal diphtheria may be complicated, he mentions Hooping Cough, Measles, Scarlet Fever, and Smallpox. As all these diseases may be associated with laryngitis, great care has to be exercised before accepting a diagnosis of diphtheria when they are present. In measles and scarlet fever especially, the laryngeal symptoms generally appear in the pre-eruptive stage and abate with the appearance of the rash. The symptoms commonly found are, aphonia, stridor and cough, but paroxysms of dyspnoea are absent, or not marked, and cases are less likely to get progressively worse. The aphonia may remain for some time. In one case of scarlet fever, the symptom was present for nearly three weeks.

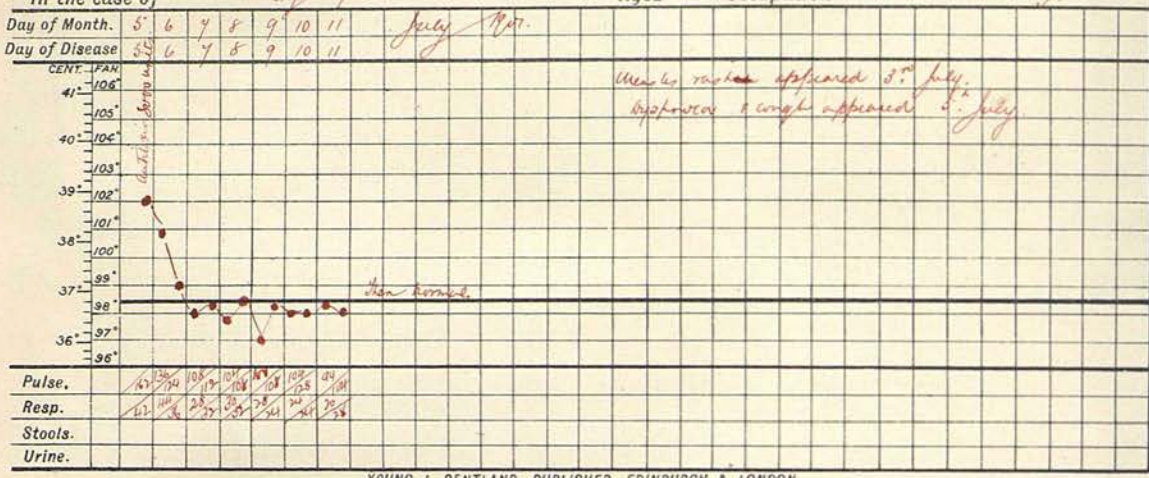
In Enteric Fever also, laryngeal symptoms may appear/

in a case of Laryngeal Diphtheria following Measles

Records of Temperature, Pulse, Respiration, Stools and Urine, from Day of 18

In the case of *Mary Lynch*

Aged 2 Occupation *Recovering*



appear about the height of the disease. These are not generally due to the formation of a diphtheritic false membrane, although Murchison⁽⁷⁾ points out that he has seen several cases where diphtheria was the cause.

It is well known that true diphtheria does follow measles and in two cases, the diseases were associated. In a third case, there was an interval of two weeks before diphtheria appeared. In one of the two first mentioned cases, the symptoms appeared two days after the rash had gone and persisted for two days before patient was sent to hospital, as she was, at midnight on the second day. On admission, the skin showed the marbling of the skin so common after measles. The respirations were 42 per minute and stridor was marked. The voice was hoarse and there was marked indrawing above the clavicles and at the lower part of the chest. The colour was fair, pulse 162 and regular. The fauces were congested. The tonsils enlarged, but free from exudation.

The child was immediately put to bed and 8000 units of antitoxin injected. It was deemed wise to be prepared for tracheotomy. During the night, stridor continued and there were several severe attacks/

attacks of cough and dyspnoea. Next morning, there was improvement but stridor, hoarseness and cough were still present. Chest showed signs of bronchitis. Next day, third after admission, and fifth from onset of symptoms, the stridor was practically gone.

In the second case, the symptoms appeared four days after the rash came out. The parents noticed that the child was breathing badly and that the cry was somewhat hoarse. During the night and the next day, the symptoms continued, and on the second night became much worse. On the evening of the third day, the child was brought to hospital.

On admission, it was found to be very badly nourished. There was no sign of a rash, and signs of obstruction were marked. The pulse was very poor, but there was a fair amount of colour in the lips. The left tonsil was enlarged and showed small quantity of exudation. Films from a swab revealed only cocci. The same treatment was employed as in the first case and in three days, there was very marked improvement.

One concluded that these were cases of diphtheria because of the paroxysmal character of the attacks of dyspnoea and because of the steady augmentation/

mentation of the symptoms till antitoxin was given. The laryngitis of measles usually appears before the rash and tends to improve rapidly after it does appear.

Both these cases also came from a locality where diphtheria was rife.

With regard to the concurrence of Laryngeal Diphtheria and Hooping Cough, Guersant quotes a case of this kind published in the Révue Médicale. The observer who described the case gave it as his opinion, since the patient recovered, that the shocks of the Hooping Cough, by promoting the discharge of the membrane, contributed to the favourable termination.

In the present series, this complication occurred once. The patient was a boy, one year and six months old, and on admission there were marked signs of obstruction to respiration. The fauces were covered with exudate and there were frequent paroxysms of Hooping Cough. Antitoxin, 6000 units, was injected, but no improvement taking place, tracheotomy had to be performed. Breathing was relieved, but the paroxysms of coughing recurred at intervals and the heart failing, the patient died on the third day after admission.

The/

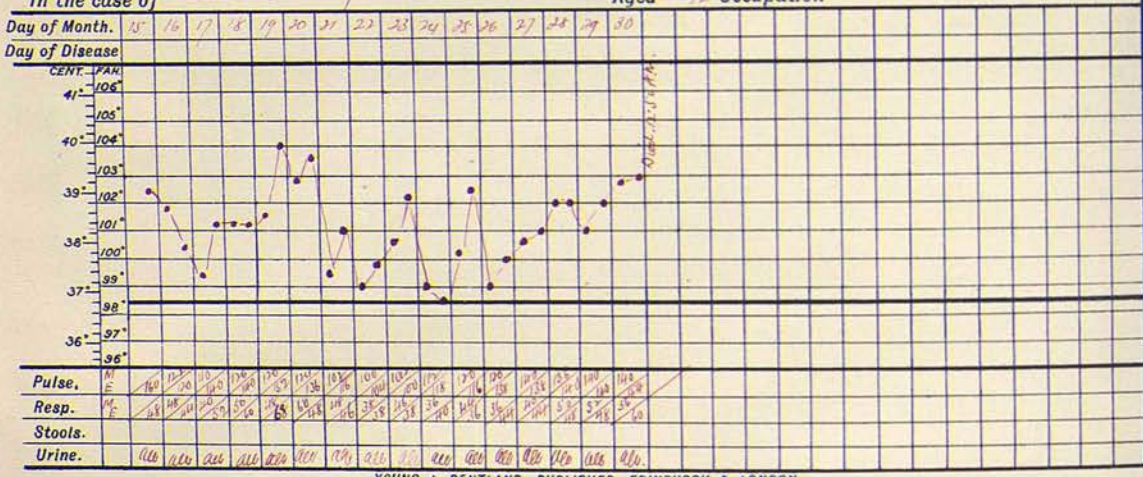
in laryngeal diphtheria, tracheotomy, Pyo-pneumothorax. Death.

Records of Temperature, Pulse, Respiration, Stools and Urine, from Day of

18

In the case of *Charles Campbell*

Aged *4 9/12* Occupation



The other complications met with, were pyo-
pneumo thorax in one case, pericarditis in another,
both appearing after the trachea had been opened.

The first case was admitted to the Leith Fever Hospital on September, 15th, 1900 with the history that he had turned croupy on the 8th. This continued, getting worse, till he took to bed on the 11th. A diagnosis of "croup" was given, but no antitoxin was injected, the case being regarded, apparently, as one of croup not due to diphtheria; this, despite the fact that at least two cases of diphtheria had occurred in, and been removed from the same stair.

Instead of antitoxin, cough mixtures were given and poultices applied, but no improvement took place during the five days they were used, and the child, a boy of 5, was eventually sent to hospital.

On admission, breathing was found to be 48 per minute and stridulous; pulse 100 and like the colour, fair. The voice was hoarse, but the cough had a certain amount of tone in it. The soft parts showed considerable indrawing; examination of chest negative. The tonsils were clean, but large and congested; temperature 102.4.

Antitoxin, 4500 units, was administered and the boy/

boy put into a steam tent. This was at mid-day; at first there was slight improvement, but at 6 p.m. tracheotomy had to be performed and a large piece of membrane removed.

On September 17th, bronchial secretion showed signs of drying up, breathing and pulse became more rapid, and there were attacks of coughing which exhausted the patient without leading to much discharge. A spray of Sod. Bicarb. grs. XV to the ounce of sterile water, was used and seemed to allay the irritation.

On the 18th and 19th September, there was restlessness and difficulty and rapidity of the breathing, the face being rather flushed, and in the early hours of the morning of the 19th, there were several attacks of dyspnoea during which the colour became very bad. Strophanthin hypodermically and inhalations of oxygen seemed to help the pulse and colour. At 6 p.m., the temperature was 104° , respirations 68 and pulse 152 per minute.

The 20th, 21st and 22nd were uneventful. The temperature remained elevated, but the pulse and respirations were slower.

On the 23rd, the temperature began to rise, reaching 103° , pulse 126, respirations 46. Cough was troublesome and examination of the chest showed consolidation at the right base.

Till September 26th, there was little change; on this day, there appeared from the left ear a foul smelling discharge. Chest as before, temperature varying up to 102° , pulse and respiration to 146 and 52 respectively.

September 27th, discharge from ear less marked. No improvement in general condition.

On September 28th, an erythematous eruption appeared on the chest and abdomen. This may have been due to antitoxin, but was probably septic in origin. The boy was very pale.

The tracheotomy tube was removed and the material coughed up, from being muco-purulent, was now copious, purulent and foul-smelling.

The note at the right base up to the level of the inferior angle of the scapula was somewhat amphoric; above this, it was dull.

All next day, September 29th, the boy was restless. The breathing was rapid and the right side of the chest bulged somewhat. The note at the base was now more dull in character. The breath and the discharge had a very offensive odour and to overcome this, towels sprinkled with Formalin were hung up in the tent.

Next day, he was much worse. He had slept none/

none all night. The breathing was shallow, 56 - 60 per minute, and the pulse very rapid and poor. Right chest greatly distended and liver dulness obscured.

Towards evening, the boy began to sink, breathing rapid, irregular and shallow, and pulse very feeble. Weakness increased and death occurred at midnight.

Post Mortem.

The distended condition of the right chest was very distinct and in lifting the body, a loud bubbling sound was heard proceeding from that side. On opening the Thorax a quantity of air escaped; the right lung was collapsed, and lying in the pleural cavity, was about eight ounces of purulent fluid.

At the apex the pleura was flaked with pus; the lung tissue was consolidated and greyish white in colour. The lower lobe was darker red, and on the posterior surface was a perforation about the size of a sixpenny bit leading to a cavity with a dirty white, ragged wall, about the size of a walnut.

Examination of the pus revealed streptococci. Elsewhere, there was nothing of note.

Broncho-pneumonia/

Broncho-pneumonia after tracheotomy is fairly common, and it is probable in this case that such a condition arose, abscess formation, as the result of the action of the streptococci, following. Later, this abscess ruptured into the pleural cavity, giving rise to the appearances described.

The case complicated by Pericarditis was also one in which tracheotomy was performed. On the 3rd day after operation, the pulse was less satisfactory. It was feebler and digitalis was ordered. The patient improved somewhat and though very restless and feverish, did fairly for some days.

Bronchial secretion dried up at times, and the boy had frequent attacks of restlessness.

On the 10th day, the pulse became very weak and gradually failed till death occurred.

Post mortem examination revealed pericarditis only, although there had been during life no signs of the disease.

Apart from the cases mentioned, there was no other complication in the series.

In connection with the Differential Diagnosis, many of the points have been referred to already.

The diseases which one has most commonly seen mistaken for, and notified as membranous croup, are:-

1. Simple laryngitis,
2. Laryngitis associated with measles or Scarlet Fever.
3. Simple and Suppurative Tonsillitis.
4. Capillary Bronchitis.

In addition to these, Goodall and Washbourn give:-

Membranous Laryngitis,

Retro-pharyngeal abscess, or growth external to the larynx.

Foreign body in the larynx,

Laryngismus Stridulus,

Abductor paralysis,

Ulceration of the larynx,

Laryngeal growth,

Oedema Glottidis.

The differentiation of a Simple Laryngitis from Laryngeal Diphtheria must always be a matter of great difficulty, and that especially in the early stages. At this period, the condition of the patient gives very little help and one has to depend on the history of exposure to cold or other irritant on the one hand, and exposure to the infection, on the other.

Very little help may be got from these, and unless/

unless a very thorough examination clears away all doubts, it might be well to take the more serious view and to administer antitoxin.

If there is membrane present on the fauces, or if there is nasal discharge to suggest diphtheria, then there can be little doubt as to the diagnosis. In cases in which there is no exudation on the fauces-and in 9 of the 43 cases considered, there was none - it is less easy. Bacteriology will prove of service in this stage and any exudation visible should be examined for Klebs-Löffler. If there be no exudation, a rubbing should be taken from as far down the pharynx as possible and the organism sought for in that.

After two or three days, a diagnosis from the symptoms alone, is less difficult for, in all probability, the metallic cough, the aphonia and the suffocative attacks will be present. In the simple inflammation, the voice is hoarse and does not become so absolutely dull and toneless as in the other condition. The cough, too, is less metallic than hoarse and like the stridor, is more noisy than in diphtheria. There is less tendency also to a progressive increase in severity and attacks of dyspnoea are absent.

Depression/

Depression is not a marked feature. Indrawing of the interspaces is rarely so noticeable, and an examination of the chest is more likely to reveal the signs of bronchitis.

When the Simple Laryngitis is associated with high fever, the restlessness, anxiety and dyspnoea are all much more marked and the diagnosis is always more difficult. The very fact, however, that there is high fever should put one on one's guard, and the possibility of one or other of the exanthemata should, at once, be considered and a thorough examination made for further evidence. Dr Caiger, in his paper on "Early Diagnosis of Specific Fevers", read at the meeting of the British Medical Association, in 1901,⁽⁸⁾ laid great stress on the help to be obtained from the presence of Koplik's spots in the early diagnosis of measles. In any case of laryngitis such as has been mentioned, these spots might be sought for with the hope of excluding measles. They are, it may be mentioned, very small white spots, very few in number, surrounded by an area of redness and situated usually far back on the mucous membrane of the cheek near the molar teeth. They are not always present and can only be demonstrated with certainty when the light is very good.

In/

In the same paper, Dr Caiger, in dealing with the diagnosis of membranous laryngitis from simple laryngitis, referred to the view expressed by Niemeyer that, while in the former expiration and inspiration are equally obstructed, in the latter inspiration is most affected. He refused, however, to accept this opinion and insisted on the value of a bacteriological examination of any exudation or of a rubbing from the pharynx.

In any case, where there is any doubt, the patient should have the benefit of that doubt and an injection of antitoxin.

The points, therefore, which would suggest that the croup is the result of simple, rather than membranous laryngitis are,

1. History of exposure to cold or irritating vapour, and absence of all possibility of exposure to diphtheria.
2. Absence of irritating nasal discharge, or of exudation on the fauces.
3. Absence of metallic cough.
4. An hoarse voice, a good colour, slight indrawing, and noisy stridor without exacerbations of dyspnoea.

If in addition, there are signs of bronchitis, it would be safe probably, to diagnose simple laryngitis. If there was associated high fever, measles, or scarlet fever might be suspected and further/

further evidence sought. In the absence of such evidence even, it would be better to isolate the patient.

The obstruction to breathing, the result of enlargement of the tonsils, is not infrequently described as croup and often in diphtheria of the fauces, the snoring breathing, due to greatly enlarged tonsils, is taken as evidence that the larynx has become involved.

Suppurative Tonsillitis is not common in young children and its symptoms are therefore rarely mistaken for those of laryngeal diphtheria. In one case, a child of eight months, there had been so much obstruction that a diagnosis of Croup was made and the child dispatched to hospital in the early hours of the morning for immediate tracheotomy.

On admission, the breathing was found to be "snoring"; there was no indrawing and the colour was good although the child was a little pale. Examination of the fauces shewed the right tonsil greatly enlarged and jutting across the middle line, displacing the uvula, to meet its fellow of the opposite side. On palpation, there was marked fluctuation and puncture with a scalpel removed the symptoms by allowing of the escape of a large quantity of yellowish pus.

Capillary Bronchitis has, on several occasions, been the only condition discoverable on examination of cases notified as membranous croup. Dyspnoea may, of course, be very marked in such a case and if it happen that there is slight laryngitis or tracheitis present, the cough may be rendered slightly stridulous and in this way the error may arise. In these cases indrawing is generally not marked; the breathing is very rapid and the cough lacks the paroxysmal and husky character of the cough of laryngeal diphtheria.

As regards the diagnosis of membranous laryngitis due to diphtheria bacilli from the same condition produced by other agents; from the symptoms alone, this must be almost impossible and indeed it is, at present, fairly generally stated that in the majority of instances, membranous laryngitis is diphtheria of the larynx. Foord Caiger, at all events, takes this view, and, as already pointed out, even after repeated unsuccessful examinations of a membrane, one should be careful in pronouncing the case one of simple membranous laryngitis.

In the case of Retro-Pharyngeal Abscess the breathing will again be snoring. In one instance of this disease, the symptoms described by the mother/

mother of the child were "sore throat and croup"; inspection, however, revealed the bulging pharyngeal wall and palpation lead to the detection of distinct fluctuation.

The symptoms resulting from the presence of a Foreign Body in the Larynx may give rise to a difficulty in diagnosis. The history in such a case, the suddenness of the onset, and the fact that the difficulty in breathing is greatest with inspiration should be of assistance.

Examination with the laryngoscope and exploration with the finger should be undertaken in doubtful cases.

Many, indeed, recommend the use of the laryngoscope in all cases of croup; such a procedure is, however, difficult or even impossible in children, and in one case in which there was doubt, the introduction of the laryngoscope mirror - by a skilled laryngologist - produced a spasm which nearly resulted in the death of the patient.

Laryngismus Stridulus is not often, apparently, mistaken for laryngeal diphtheria. Its sudden onset, generally at night, the fact that it affects mainly, infants and especially those who are the subjects of rickets, and that, in the interval between the spasms, there is no stridor, should make its diagnosis easy.

Interference/

Interference with the Nerve Supply of the Larynx may lead to stridor. In children, paralysis may be post-diphtheritic, and, in adults, the laryngeal crises of locomotor ataxia may, by leading to laryngeal spasm, cause stridor.

The history in the latter case and in the former case, the presence of other paralyses, e.g., of the palate and information as to a previous attack of diphtheria would be of assistance in arriving at a conclusion.

Oedema of the Glottis may have to be diagnosed from laryngeal diphtheria. The history may give some indication, e.g., erysipelas, or exposure to an irritant, hot steam or acid or other vapour, would at once put one on the track.

In making a diagnosis, the main points to be attended to in any case, are:-

1. The nature of the stridor, and this having been determined, the site of the obstruction will be determined.
2. The history should be gone into with care; exposure to cold, exposure to irritants, and exposure to the infection of diphtheria should all be asked about.
3. A thorough examination of nose, throat and chest should be carried out.
4. Bacteriology should be called in to help, but in diphtheria delays are dangerous, and if one is sure that one has examined carefully and there is a possibility of the symptoms being the result of diphtheria of the larynx antitoxin should be administered.

Having done so, the best is done for the patient, and time can be given for the diagnosis to clear itself by - the discovery of Löffler Bacilli- the development of a measles rash or the passing off of the symptoms.

LARYNGEAL DIPHTHERIA IN ADULTS.

Difficult though the diagnosis is in children, still more difficult is it in the case of adults. In them, the condition is rarer and this renders recognition all the more difficult by putting one off one's guard.

In the early years of the last century laryngeal diphtheria seems to have occurred not infrequently among adults. Bretonneau mentions that George Washington died of the disease and refers to many cases in his own experience, some of the patients being over 20 and others over 30 years of age.

In more modern works, instances are less common and, though it be admitted that, as opinions on diphtheria were at the period referred to, undergoing a change and every case was being published, it still would appear that now-a-days, in the adult, the larynx is more rarely involved.

Within/

Within the space of a few months one had under treatment three cases; in one, a man of 30, the disease began on the fauces and spread to the larynx producing aphonia and slight stridor; in the remaining two, a girl of 21, and a man of 36, the condition seems to have begun primarily in the larynx for there was no evidence of membrane elsewhere.

In the first case, the symptoms rapidly disappeared under antitoxin; in the others, the obstruction was more marked and tracheotomy was called for.

The first of these two latter cases to be seen was the man who was notified as suffering from "membranous Croup(?)". Removal was requested, but the notifying physician warned me that as the patient was an adult, he could not be sure of his diagnosis, yet he could not bring himself to send the patient to a general hospital.

The history obtained from the man was that he had been perfectly well till four days before, when he noticed that he was a little breathless and that his voice was rather hoarse. This was in the morning and as he improved during the day, he thought no more of it. Next day, lying down after return from/
his

from work, the breathlessness returned, but passed off in a short time not to return till the next night, after he had gone to bed. Next morning - the day before admission- he got up and went out and did a good day's work. In bed, at night, however, breathlessness returned and recurred at intervals till he was admitted.

The condition on admission was as follows:- he was restless and excited and complained of pain on swallowing or coughing. He was a strong muscular man - a blacksmith to trade. The facial expression was anxious though he seemed to get plenty of air with each inspiration. The voice was husky and the fauces congested, but free from exudate. The glands at the angles of the jaws were not enlarged. There was no evidence of aneurysm or intra-thoracic disease of any description.

The Public Health Department knew of no cases of diphtheria in the neighbourhood and the patient knew of no sore throats in his stair nor among the members of his own household.

The symptoms and the history, to a certain extent, suggested diphtheria of the larynx so anti-toxin, 6000 units, was injected and a steam tent erected; this improved matters and only slight stridor/

stridor was apparent. In about an hour, however, a spasm of dyspnoea occurred. This lasted a few seconds and then passed off. During the attack the glottis seemed to close completely and remained so till suffocation seemed imminent when it opened and allowed air to pass in. This was followed by an attack of coughing which lead to the expulsion of a small quantity of mucus. After a period of quietness, in which breathing was slightly stridulous, another spasm occurred in all respects similar to the first.

An attempt was now made to examine the larynx with the laryngoscope. This was almost impossible as the slightest attempt was followed by an attack of dyspnoea and all that was discovered was that the epiglottis was congested and red, but free from membrane. Tracheotomy was determined upon, but before he could be got upon the table, an attack, more severe than any which had gone before, occurred, and, death seeming imminent, the trachea had to be incised at once; in the coughing which ensued a small piece of membrane was expelled, which, when examined, showed no bacilli.

The resulting improvement lasted for a part of the night only. In the early hours of the morning/

morning bronchial secretion began to dry up; the temperature began to ascend, reaching before death, which occurred at 6.30 p.m., 107° F.

At the post mortem examination, the epiglottis was found swollen and oedematous; lying on the left epiglottic fold there was a thick piece of membrane and the mucous surface of the larynx, from the tip of the epiglottis to the cricoid cartilage, was covered with a soft, friable membrane. The interior of the larynx contained a small quantity of pus.

Examined bacteriologically, the membrane showed Klebs-Löffler bacilli and streptococci, and films made from a rubbing from the mucous tissue beneath revealed the same organisms.

A few days after his death, the patient's daughter was admitted to hospital suffering from diphtheria.

The second patient mentioned, was a probationer in the Leith Public Health Hospital who, with the exception of two hours spent in the diphtheria wards two weeks before she became ill, had been engaged in nursing scarlet fever.

The history of the illness is as follows:-
On the morning of March 10th, 1901, she felt her throat/

Records of Temperature, Pulse, Respiration, & Stools

In the case of

Maxon B

Day of Month. 12 13 14 15 16 17 18 March 1907

Day of Disease 3 4 5 6 7 8 9

CENT. FAN

41° 106°

40° 105°

39° 104°

38° 103°

37° 102°

36° 101°

35° 100°

34° 99°

33° 98°

32° 97°

31° 96°

30° 95°

29° 94°

28° 93°

27° 92°

26° 91°

25° 90°

24° 89°

23° 88°

22° 87°

21° 86°

20° 85°

19° 84°

18° 83°

17° 82°

16° 81°

15° 80°

14° 79°

13° 78°

12° 77°

11° 76°

10° 75°

9° 74°

8° 73°

7° 72°

6° 71°

5° 70°

4° 69°

3° 68°

2° 67°

1° 66°

0° 65°

36° 95°

35° 94°

34° 93°

33° 92°

32° 91°

31° 90°

30° 89°

29° 88°

28° 87°

27° 86°

26° 85°

25° 84°

24° 83°

23° 82°

22° 81°

21° 80°

20° 79°

19° 78°

18° 77°

17° 76°

16° 75°

15° 74°

14° 73°

13° 72°

12° 71°

11° 70°

10° 69°

9° 68°

8° 67°

7° 66°

6° 65°

5° 64°

4° 63°

3° 62°

2° 61°

1° 60°

0° 59°

36° 95°

35° 94°

34° 93°

33° 92°

32° 91°

31° 90°

30° 89°

29° 88°

28° 87°

27° 86°

26° 85°

25° 84°

24° 83°

23° 82°

22° 81°

21° 80°

20° 79°

19° 78°

18° 77°

17° 76°

16° 75°

15° 74°

14° 73°

13° 72°

12° 71°

11° 70°

10° 69°

9° 68°

8° 67°

7° 66°

6° 65°

5° 64°

4° 63°

3° 62°

2° 61°

1° 60°

0° 59°

36° 95°

35° 94°

34° 93°

33° 92°

32° 91°

31° 90°

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14° 73°

13° 72°

12° 71°

11° 70°

10° 69°

9° 68°

8° 67°

7° 66°

6° 65°

5° 64°

4° 63°

3° 62°

2° 61°

1° 60°

0° 59°

36° 95°

35° 94°

34° 93°

33° 92°

32° 91°

31° 90°

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12° 71°

11° 70°

10° 69°

9° 68°

8° 67°

7° 66°

6° 65°

5° 64°

4° 63°

3° 62°

2° 61°

1° 60°

0° 59°

36° 95°

35° 94°

34° 93°

33° 92°

32° 91°

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3° 62°

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1° 60°

0° 59°

36° 95°

35° 94°

34° 93°

33° 92°

32° 91°

31° 90°

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10° 69°

9° 68°

8° 67°

7° 66°

6° 65°

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4° 63°

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36° 95°

35° 94°

throat painful, but it was very slight and she complained of nothing till the following morning, when she reported that she had lost her voice. On examination, there was congestion of the fauces, a slight cough, and huskiness of the voice. There was no rise of temperature and she went on duty. Next morning she again went to her ward. At 10 a.m. however, she complained of a feeling of "chokiness" and had to go to bed, where she was more comfortable though there was huskiness of the voice and at times a little stridor. As the day wore on, one became more impressed by this stridor and injected 8000 units antitoxin. The stridor, however, increased and eventually tracheotomy had to be performed.

After opening the trachea there was no relief till a large piece of membrane had been removed. Improvement continued a very short time, the tube becoming blocked by membrane further down the trachea. A second dose of antitoxin, 4000 units, was given, and since the tracheotomy tube was continually being blocked it was removed the tracheal wound being kept open by Spence's tracheal dilators.

In a few hours, more thick, tough membrane,, probably loosened by the antitoxin, was expelled and the tube re-introduced.

To/

To keep the mucous membrane moist and to aid separation of the membrane the spray of sodium bicarbonate was employed and seemed to help. Restlessness was, however, a marked symptom and the attacks of dyspnoea, which recurred from time to time, were so intense that it seemed as if death might result from suffocation.

During three days she continued in this condition, from time to time expelling thinned out pieces of membrane. At the end of this period, however, she began to improve. The dyspnoea passed away, and by the sixth day after the operation, the tube was removed. At the end of five weeks, she was discharged from hospital well, but died two days later at her own home while undergoing an operation for what was said to be "an abscess in the wind-pipe."

These two cases are interesting, not only because the condition is rare, but because they are both, to all intents and purposes, examples of primary laryngeal diphtheria, which is itself rare, Lennox Browne⁽⁸⁾ holding that he has never failed to find a direct continuation from the fauces.

The great enlargement of the epiglottis in the first case was also of interest and doubtless increased/

increased the dyspnoea to a very great extent although the membrane present was quite sufficient to account for it. One was inclined to believe the oedema was the result of the action of streptococci, the infection being mixed bacillary and streptococcal.

In dealing with the diagnosis of laryngeal diphtheria in the adult Goodall and Washbourn⁽⁹⁾ state that, "loss of voice with dyspnoea, however slight, should suggest that the larynx has been invaded." In the first case of all, the man who recovered, these indications were present, but in the nurse's case, aphonia preceded dyspnoea by at least 24 hours and in the blacksmith, this would seem to have been so also.

In adults loss of voice is not an uncommon sequel to exposure to cold and damp, and in their case, as a rule, laryngeal diphtheria is not the first thing one would think of. Unfortunately, the delay which results gives the bacilli a start and the gravity of the prognosis is greatly increased. Bearing the case of the nurse in mind, one will always very carefully, and by every available means, endeavour to exclude diphtheria from the possible causes. Where there is membrane on the/

the fauces there need be little difficulty in excluding everything but diphtheria and the indications for treatment are clear. Where, however, there is no exudation, great care must be exercised and the addition of stridor to aphonia of some hours' duration should be taken as proof of the existence of laryngeal infection.

The steady growth of the symptoms is well described by Bretonneau who refers to the case of a Jew, who "bore for a week without much uneasiness, his slow and fatal asphyxia."

In the man's case one considered the possibility of an intra-thoracic growth, a foreign body in the larynx and of laryngeal crisis. The first and last were easily excluded. The second gave more difficulty.

In the nurse's case, as already mentioned, the only condition considered was simply laryngitis from exposure and only when stridor and dyspnoea appeared did one think of anything else.

PROGNOSIS:

In Laryngeal Diphtheria this depends upon many circumstances. At all times serious and calling for at least a guarded prognosis, the gravity of the/

the case varies greatly with the age of the patient, and with the duration of the disease. If tracheotomy has been necessary, another element of danger is introduced and the outlook becomes even more serious. The gravity is also increased by the presence of any complicating condition, e.g., bronchitis, pneumonia or whooping cough.

Out of the 43 cases, 8 died; Four of these were under two years of age, one being 10 months, one 16, and two 18 months old.

Two were under five; one 3 and one 4 years and 9 months. One was exactly 5 years of age. One only was over 15, viz., the blacksmith, aged 38, whose case has been described.

The nurse's death was scarcely directly due to diphtheria and is not included.

Of the total number, nine were two years of age or under, and of these four died = 44.4%

Of children between two and five, there were admitted 24, three of whom died, a mortality of 12.5%; between five and fifteen, 7 were admitted. There were no deaths at this period.

Three persons over 15 were under observation, and one died - the mortality being 33.3%.

These figures bear out the statement made by Goodall and Washbourn that invasion of the larynx and/

and trachea is much more serious in patients under two and over fifteen than it is in those of intermediate years.

With regard to the influence of the duration of the disease on the prognosis, all over, the majority came under treatment on the fourth day. The average day for those who died was the fifth, two being admitted on the eighth day and one on the second day of illness.

Such statistics would seem to show that the day on which treatment was begun made little difference, but one day in such a disease may mean much, and besides, the accuracy of the observers is not always to be depended upon.

The mere fact that tracheotomy is necessary shows that the condition has advanced a very considerable distance and that the outlook is serious. Of the eight patients who died, all had been tracheotomised, but further reference will be made to this in considering tracheotomy.

As to complications and associated diseases, one case was, as already mentioned, complicated with whooping cough and death resulted. In the cases in which pyo-pneumo thorax and pericarditis were found, it seems likely that these followed the tracheotomy.

Asked/

Asked for a prognosis where the larynx is involved one must be careful. If the involvement is slight and tracheotomy is not necessary, and antitoxin can be given at once in full doses, it may be prognosed, as in faucial diphtheria that, provided no cardiac or serious paralytic symptoms arise, recovery will take place.

If the obstruction be more marked, if antitoxin has been injected and if say, 24 hours have passed without the necessity for tracheotomy arising, a similar prognosis may be given.

If tracheotomy has been necessary, the prognosis must be even more guarded and a serious view must be entertained till, at least, the tube is out and the wound closed. Even then, as the case of the nurse shows, caution has to be employed.

TREATMENT:

Since the introduction of antitoxin, both the prognosis and the treatment have had to be altered. Formerly, in cases caught early the spread of the membrane might be stayed and recovery follow, but, too often nothing did any good, and death resulted from suffocation, cardiac failure, exhaustion or complicating conditions in the lungs.

In/

In these days the mercurial treatment so lauded by Bretonneau⁽¹¹⁾ in his memoirs seems almost as heroic as the use of such nostrums as the older physicians recommended must have appeared to him, and yet, both he and they have recoveries to record; he, with two grains of calomel every half hour to a child of 30 months and they, with preparations less pleasant to think of, but probably less depressing in their action.

Guersant⁽¹²⁾ and Bouchut⁽¹³⁾ in their treatises on croup, both strongly recommend the mercurial treatment. Bouchut gives as an aphorism that, "croup should be treated by repeated emetics, alternating with doses of calomel." The former states that he has had three recoveries under its use. Bretonneau claims to have had seven.

By these physicians, Mercury was supposed to act as an "alterative"; the cough diminished and lost its special character and the expectoration became much more fluid. There were objections to its use, severe stomatitis being one.

The value of blood letting was, at this time, beginning to be doubted, Bretonneau indeed, held that it was harmful, but Guersant, though admitting that the disease generally advanced in spite of bleeding/

bleeding, considered that, especially in strong children and adults, if suffocation was imminent in the early stages, by retarding the supervention of asphyxia time was given for other remedies to act.

Emetics were commonly employed, and this method seems to be the one of all they recommended to live long, but it, like the others, is now dropping into disuse.

Other methods of treatment also had their exponents, the object in the majority of instances being the expulsion of the membrane by stimulating the patient to sneeze or cough.

In most cases these means failed to get rid of the exudate and to prevent its spread, recourse was had to local applications. Of these, silver nitrate was apparently the favourite. To get it into the larynx, the epiglottis was lifted up and "pitilessly held" till the sponge, soaked with the solution, was applied to the glottis, and by the convulsive respirations which followed the mixture of mucus and silver nitrate was sucked into the windpipe. Other caustics recommended, were nitric acid and hydrochloric acid.

Up till the introduction of antitoxin the methods were very little changed. Emetics were employed/

employed fairly generally and though condemned by some, and with good reason, yet in the majority of cases, Ipecacuhuana was administered in the hope that it might do good by loosening the membrane during emesis. Even now, it has not passed out of use and Carbonate of Ammonia for the same purpose is still recommended. Lennox Browne⁽¹⁴⁾ defends the use of the former on the ground that, by acting as a depressant, it lessens laryngéal spasm. Gold Chloride is also recommended for this same reason. One has had an opportunity of performing tracheotomy on a child who had been dozed with this substance and can testify to its powers as a depressant.

Dissatisfied with Calomel and with Caustics, Bretonneau in 1818 took to Tracheotomy. According to Trousseau⁽¹⁵⁾, this operation was first performed in London in 1782 by one John André, and it was later introduced into France. Its performance, however, was forbidden by the Académie de Médecine and it dropped into disuse till Bretonneau revived it and operated in 1818 and 1824 but without success. His next attempt was made in 1825 and was successful and up till 1835 he had opened the trachea on 14 occasions and had had four recoveries.

Trousseau himself operated on 36 children and saved 9 and reckoned that, including the first case - that/

that of John André - up till 1835, there were 18 recoveries out of about 60 operations.

These results he thought highly satisfactory, but discussed the following questions:-

1. Is the operation necessary?
2. Being deemed necessary, at what period ought it to be performed?
3. Having been performed, what are the methods of ulterior treatment?

His answer to the first question is that, as it is a physician's first duty to prolong a patient's life and as tracheotomy can do so, it ought to be performed. To those who say recovery might have occurred without interference, he replies that, in all the cases operated upon, nothing was done till the symptoms present were those which always announce a fatal termination. He concludes that the operation ought to be performed when the symptoms lead us to believe that in all probability there remains no other resource.

The operation is, in his opinion, rather delicate than dangerous, care and presence of mind only being required. Haemorrhage, he disregards, and advises that the veins be not tied. Risks of pneumonia there certainly are, but, the less lowering the previous treatment has been, the less risk there is of such a sequel.

As/

As to the time when the operation should be performed, he says:- "As long as tracheotomy was in my hands a measure of almost uniform danger, I said, 'It must be performed as late as possible,' but now, when I have had numerous successful cases, I say, 'It must be performed as early as possible.'"

Under the third heading, viz., the methods of ulterior treatment, Trousseau describes the method of clearing out the trachea with the *écouvillon* of Bretonneau, and considers the method of cauterization by "touching" and by instilling caustics after the trachea has been opened.

After reading a description of the two kinds of *écouvillon* - the sponge on whale bone and the brush similar to that which is used to clean bottles - and learning that water has to be dropped in before the brush is introduced to a depth of 3, 4 or 5 inches and rotated and worked up and down for two or three seconds, one is rather glad that this treatment is no longer used despite the assurance that, most frequently, children who are asleep are not aroused by it!

His description of the operation itself, of the canulae to be used and of the accidents which may occur during the performance of tracheotomy is very/



very full and clear and his method differs little from that now followed.

He advises the canulae introduced by Bretonneau which he himself modified by having a dorsal opening made which is to lie close to the posterior extremity of the instrument so that it may be entirely in the trachea and act as a direct communication between the trachea and the larynx when the mouth of the canula is blocked.

Despite Trousseau's high commendation, the operation was never really very popular, partly because practitioners were pessimistic and partly because parents thought it a shame to give their children more pain when, in any case, death was inevitable. Just now, however, it is more in favour and Lennox Browne⁽¹⁶⁾ writing of tracheotomy says: "mainly because the indications for its performance are becoming better appreciated, the results are, year by year, becoming more favourable and parents can be assured that, if adopted sufficiently early, the chances of success are greater than formerly." Still, it must be admitted there are those who are sceptical, and too often, an ambulance sent to remove a patient returns empty, death having occurred before removal was possible.

In/

In the 43 cases considered tracheotomy was performed 22 times. The ages varied from 5 months to 38 years and there were 8 deaths, a mortality of 36%, the average rate, in these days, being probably between 30% and 50%.

In every bad case admitted, one endeavours as far as is consistent with safety to make tracheotomy a last resource. Though one's results have been good and one is always struck by the improvement which follows the opening of the trachea and the calmness which seems so come upon the patient after the long struggle for breath, yet one has always the dangers in mind.

It, undoubtedly, is an added risk and if the colour is at all good, if there is any improvement after the excitement of the journey to hospital is over, a large dose of antitoxin, 12000 units or more, is injected and palliation attempted till the drug has time to act.

If the patient can be tided over say, six or eight hours in this way, recovery may be hoped for without interference, but if there are no signs of improvement after two or three hours, if the skin and lips show any duskiness, if indrawing is becoming marked and dyspnoeic attacks are becoming more frequent/

quent, if, above all, the pulse shows an increased rapidity and feebleness, there should be no delay.

It is difficult always to say exactly how long one may wait in a given case, but there should never be any hurry. Everything should be ready for operation. If the patient is voiceless and very dusky and there is marked obstruction as shown by the indrawing and possibly a pulsus paradoxus, the excitement of the journey often accounts for a good deal of this and some improvement may follow the removal of blankets and wraps. This improvement may be slight, but it should be borne in mind so that hurry may be avoided.

The most difficult case of all is the one in which there is a certain amount of healthy colour, but where there is indrawing and huskiness and rapidity of pulse. Is there a chance of recovery under antitoxin alone? Should one operate at once or wait? Wait, have everything ready, but wait. The patient should be seen at frequent short intervals. Any change of colour should be noted and any increased rapidity of pulse and any signs of exhaustion taken as a hint to proceed.

The third class of case is that with all the signs of obstruction, but not to a marked extent. As in the first case, so in this, inject antitoxin at/

at once. Eight or ten hours, or even less will show signs of improvement and by the end of 12 or 14 all anxiety may be over, at any rate, so far as the necessity for operation is concerned.

Of these three types, the second is the difficult one, but, and this is the view of Goodall and Washbourn, ⁽¹⁷⁾ as in a hospital everything is ready against an emergency, the few hours which are given for antitoxin to get to work will not make a very great deal of difference should tracheotomy be ultimately necessary.

One must agree with the view of Trousseau that the operation should be performed preferably as early as possible, but now-a-days, we can wait longer than Trousseau could, if antitoxin has been injected.

The period which one may wait varies. Probably in six or eight hours the antitoxin will begin to make its influence felt and signs of improvement will begin to appear.

Of the 43 cases, 13 had to be operated upon almost at once; of the others, there were in 16 signs of considerable obstructions, but under antitoxin and steam, seven went on to complete recovery without tracheotomy; in the remaining nine, the operation had to be performed. In two cases only was/

was it necessary to operate later than eight hours after antitoxin. In one of these, the actual time was 24 hours; apparently the membrane had been separated by the antitoxin, but for some reason or other, possibly because of its size, it lay in the trachea and was not coughed up. The signs of obstruction were fairly marked, but disappeared immediately the membrane was removed, and the child breathed quite calmly. There was no further trouble and the tube was removed on the third morning.

In none of the others was it possible to let more than three and a half hours elapse, and though three of these died, one cannot believe the delay had any ill effect.

As regards the operation itself, the method recommended by Lennox Browne⁽¹³⁾ is that followed, i.e., it is as bloodless as possible, the knife being discarded after the skin incision is made, until the trachea is reached.

The patient is placed upon a table, the shoulders supported by a sheet rolled up and about 12 inches in circumference; the back of the head rests upon the table. If the head be allowed to hang back too far, the skin is greatly stretched and unless this is remembered when making the first incision, the opening will be found, on straightening the/

the neck again, to be somewhere over the manubrium instead of over the trachea as intended. One has several times found this displacement follow hyper-extension, and it makes the after treatment so much more pleasant and easy if the skin incision is exactly over the trachea and the tracheal opening, that it is worth while remembering it. Besides, a shorter skin incision suffices and the cicatrix is less disfiguring afterwards.

Unless the patient is very far gone, it is preferable to use an anaesthetic. In five cases, no anaesthetic was used, but one is inclined to believe that no advantage is to be gained by omitting it, the peace and comfort of working with a patient who is quiet, far outweighing any risk introduced by the use of chloroform. Some observers recommend chloroform in all cases, even though it would appear that there was no time. It allays spasm and renders the operation easier in every way.

Many consider a local anaesthetic, like cocaine sufficient. In a nervous, excitable child, the prick with the needle of the syringe may be as bad as the first cut of the knife which is, after all, the only painful part of the operation. So far as one can see, the general anaesthetic is better. The amount/

amount of Chloroform required in these cases is generally not large and there is not any very great risk in using it.

The whole neck is bared and the upper part of the chest and cleaned, with the head held firmly and straight on the middle line, the cricoid cartilage is felt for with the index finger of the left hand. This, in a fat child, may not be very easily located. When found, however, an incision through the skin only is made from it, in the middle line for about an inch. When the fat is fairly exposed throughout the whole length, the knife is laid aside and with a dissecting forceps held between each thumb and forefinger, the tissues are torn through till the deep fascia is reached. So far, there has been little bleeding, but now large vessels, distended with dark blood, alternately expanding and collapsing, become visible; these must be avoided, especially if on account of the toughness of the fascia it becomes necessary to make a small incision with the scalpel.

Like the fat, the muscular fascia is torn the whole length of the wound and the muscle is exposed. A blunt hook may now be introduced on each side of the wound and the edges and any veins held out of the way.

The/

The muscles are now exposed. Make sure that the head is held straight. Explore with the finger tip and find out the position of the cricoid cartilage, and separate the muscles. In children, what is now seen is generally the isthmus of the thyroid, its upper edge reaching sometimes as high as the lower edge of thyroid cartilage and concealing the trachea. This must be stripped off and pushed down or else divided.

To separate it from the trachea, the dissecting forceps or the handle of the scalpel may be used, the isthmus being held by an artery forceps. Sometimes this does not succeed and two forceps may be applied and the isthmus torn or cut between them; in this way five or six rings of the trachea should be exposed.

Before the trachea is opened, all active haemorrhage should have ceased. If, as is usual when the operation has been performed as described, there has only been oozing, there need be no delay. If vessels have been cut, and if they have to be cut, two forceps should be applied and the cut made between, it may be necessary to apply a ligature, though in a great many cases no ligature need be used.

Many/

Many are of opinion that, as Trousseau taught, haemorrhage ceases when the trachea is opened, on account of the free respiration and relief to the right heart. This is doubtful and it is preferable to have the wound as dry as possible.

Before proceeding to open the trachea, be sure the head is firmly held with the chin in line with the episternal notch, and see the rings of the trachea clearly. With the scalpel held pen-wise and all but a quarter of an inch of the tip guarded, push the point through the tracheal wall and cut downwards severing three or four rings.

It is better not to go too near the cricoid cartilage; Lennox Browne always endeavours to cut below the first, or if at all possible, below the second tracheal ring; this because it is held by many that, in cases in which the cricoid cartilage is interfered with, there is great difficulty in getting the patient to do without the tube. This may be so, but one has seen the same difficulty in cases in which every precaution was taken to avoid that cartilage. Bearing in mind the anxiety which a tube long retained may give rise to, if attention to such a detail as that mentioned will diminish the risk, it is worth while avoiding the first and second rings and taking those below.

When/

When the incision is made and the wound held open by Spence's dilators, improvement in the majority of cases is immediate and striking. There is calm where before there was hurry and anxiety. In some cases, there is apnoea for several seconds, as if the patient, having taken the first inspiration, wished to hold the air as long as possible.

In other cases, coughing begins at once and frothy, blood-stained mucus and possibly pieces of membrane are expelled. If coughing should not occur, a feather should be introduced and the trachea stimulated and coughing induced. There is no necessity to hasten the introduction of the tube; as much membrane as possible should be got away by letting the patient cough or by feathering the trachea.

In some cases, no improvement follows the opening of the trachea. In these, the membrane is tough and firmly adherent to the wall of the trachea. Sometimes, the point of the knife, while cutting the tracheal rings, pushes the membrane before it, in which case it bulges white and tough through the opening. At other times, the knife cuts both the trachea and the membrane, and if slight improvement occur and the tracheotomy tube be/

be introduced too soon, death may occur suddenly, later, from suffocation, the membrane separating lower down and rising and blocking the inner end of the canula. One has seen one such case, the membrane at the post mortem showing the incision corresponding to the incision in the trachea.

If no improvement follows the incision, every means possible should be employed to get rid of the membrane; if it is visible at all, an endeavour should be made to grasp it with forceps and the most useful instrument is the aural forceps which, long and narrow, can be pushed for a considerable distance down the trachea. If no membrane is to be seen, the feather must be used till the breathing improves.

When satisfied that respiration is properly started and certain that everything^{possible} has been done, the neck is cleaned and the tube, freed from the carbolic lotion in which it has been lying by washing in glycerine and boric lotion, is introduced, the dilators being held in the right hand, and the outer tube, with tapes attached, in the left, the back of the tube looking to the patient's left. Introduce now the inner end into the wound and engage it in the tracheal opening. When sure it is in/

in, rotate it till the back looks towards the chin, then, simultaneously, the left hand pushes in the tube and the right compresses the dilators and pulls them out.

This generally excites a fit of coughing and more blood stained mucus is expelled. The wound usually gapes somewhat and one is tempted often to put in a stitch. It is, however, unnecessary. The wound may be covered by taking two or three folds of sterilized gauze, slitting them for a short distance along the centre and pushing up the ends one on either side of the neck of the tube and under the tapes.

The inner tube, freed from carbolic, is next introduced; a layer or two of sterilized gauze is laid over the opening and the child put back to bed.

For the after treatment, a good nurse is a necessity and she should have nothing else to do but look after the patient. She should be instructed to remove the inner tube at intervals, or after a fit of coughing, to clean it with a feather, to wash it, heat it in the flame of a spirit lamp and to replace it. She should be directed to be on her guard in the event of any plugging of the outer tube, to/

To show rise after tracheotomy.

Records of Temperature, Pulse, Respiration, Stools and Urine, from

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In the case of

Eliza Munro

Aged 6

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Resect.

Recovery.

Day of Month.

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to be ready to pass down a feather and if no improvement follow, to cut the tape and remove the tube.

She must attend carefully to the feeding of the patient; there should be no hurry, small mouthfuls of milk being given at intervals.

In none of the cases dealt with, was there any return of fluid through the tube. Lennox Browne notes that semi-solid food is more easily swallowed and advises the adoption of feeding by the rectum or through a nasal tube if there be regurgitation.

There is usually a rise of temperature after the operation and fever continues, usually for a day or two, pulse and respiration rate also being increased. In the majority, the fourth day saw the temperature normal and respirations and pulse reduced. Only in cases in which there was developed any complication, did the temperature remain elevated longer.

After 24 hours, the patient is generally fairly comfortable. The face is often flushed, but some phlegmatic children seem to be very little upset. Cough is generally present and the mucus, which during the first few hours was tinged with blood, is now quite clear. Pieces of membrane may be discharged from time to time. To keep the secretion/

secretion fluid, a simple expectorant mixture is generally ordered; a bad sign is a tendency to drying up of the secretion. When this occurs and there is a frequent cough with no discharge, and rapid sawing respirations, the outlook is grave.

In these cases, instillation of glycerine or boroglyceride is recommended. A more satisfactory treatment is spraying with bicarbonate of soda, 15 grains to the ounce of sterile water. This frequently seems to soothe the mucous membrane and to lead to a slight secretion of mucus. Many recommend steam also in these cases, but after tracheotomy, steam is of very little use and one has never seen it do any good.

In most of the cases the outer tube was left undisturbed till the second morning after the operation. The first morning, one generally contented oneself with renewing the tapes and applying fresh gauze, unless the tube was not sweet when it was removed, cleansed and replaced. By the end of 24 hours, the wound has generally become fairly firm, but there may be some difficulty in returning the tube and the patient may become flurried and excited. For this reason, one considers it wise to wait till the following day, although many are in the/

the habit of removing and cleaning it at the end of 24 hours, some indeed, being of opinion that an attempt should be made to get the patient to do without it altogether at this early period.

After the tube is removed the patient is encouraged to attempt to breathe through the larynx and to cough or talk or blow out a match, the tracheal wound being held closed during this time. The replacing of the tube is not long delayed, however, and the patient is given no opportunity to get frightened or excited.

By the third morning, the temperature should be showing signs of settling. On this day, the tube is again removed and an attempt may be made to keep it out for good. This possibly, is rather early and in the majority of the cases ending favourably, the fifth day was chosen, although in one case, it was out on the 2nd day and in another, it was the 29th day after operation before the tube was removed.

There are some points of interest in the latter case which make it worth recording. The patient, a boy of four, was sent to hospital early one morning and had to be operated upon very shortly after admission. No anaesthetic was employed. There was immediate relief after the removal of one or two/

two pieces of membrane, and the boy did well till 11 o'clock that night, when the outer tube became blocked with membrane and had to be removed and cleared.

Three days after operation, as the boy could phonate quite well even with the canula in, an attempt was made to have him do without it, but after a couple of hours, he had several fits of coughing and stridor became so severe that the tube had to be replaced.

On the eighth day, a tube of small calibre was introduced as the wound was closing up and daily attempts were made to have it out and to keep it out, but after a time the boy would get frightened and begin to cry, a spasm of dyspnoea would occur and the wound in the neck would close firmly up and only open after strong pressure with the dilators. Many of these attacks were very alarming, the patient once or twice standing bolt upright in bed gasping for breath. As soon as the tube was replaced, the breathing became quiet.

On the 17th day, one determined to endeavour to wean the child from the tube, for it was clear that a great part of the difficulty was due to nervousness and to the fact that the child had become used to the feel of the tube. The method adopted was as follows:-/

follows:- An ordinary rubber tracheotomy tube was taken and all but the shield cut off. Through the air passage in the shield, the inner tube of a double silver canula was pushed, the tube introduced into the tracheal opening and the whole fixed by tying round the neck with tape. Daily, the tube was made shorter by pulling the silver tube a little further out and allowing less to project on the inner side of the shield into the wound.

The progress was slow, sometimes the boy was more nervous and frightened than at others and the whole length of tube had to be allowed. On the 27th day after the tracheotomy, the greater part of the tube was on the side away from the trachea, only about quarter of an inch lying in the wound, from the bottom of which, down to the tracheal opening, any channel must have been very minute. The boy breathed fairly quietly, especially when asleep. There were, however, several anxious moments during the night, but he got safely through it. Next morning, the tube was practically out of the wound and the boy fairly comfortable, so it was left as it was till about 9 p.m., when it was removed and a piece of gauze placed over the wound. That night passed as the previous one and thereafter he did well.

Before/

Before removing a tube finally, one likes to see the patient able to take an easy breath through the larynx and to phonate fairly. By the fifth day this is generally possible, and besides, the wound is firm and keeps open for three days at least and acts as an auxilliary channel. The temperature has generally been down at least two days and the respirations and pulse approaching the normal rate before any attempt is made.

One was never in the habit of removing the tube, as is recommended, for intervals of four to eight hours before the final removal. Everything is kept in readiness, however, after removal, against any suddenly arising necessity.

Trousseau⁽¹⁹⁾ found that the passage of the larynx was re-established from the 4th - 13th day, and usually he was able to have the tube out by the 10th or 13th. In one case only was he able to have it out by the 4th. Once it was as late as the 42nd and once as late as the 53rd day before it was finally removed.

"The capital precept in tracheotomy," he says, "is to withdraw the canula as soon as possible." Which is exactly the opinion now, though we seem to be earlier than they were in his day.

The/

The wound as a rule heals up quickly once the tube is removed, but it is generally two or three days before the voice obtains its former strength and clearness. For some time, it remains harsh and high pitched, but eventually it becomes toned down. In no case did the wound become infected with the diphtheritic process, a sequel very rare at any time. A condition which is said to give rise to a difficulty in removing the tube, is a projection of granulation tissue into the tracheal opening. One had an opportunity of seeing a case in which this was said to be the condition which rendered removal impossible even at the end of three months. The treatment advised is destruction of the granulations by opening up the wound and scraping them away, but in this patient, a rubber tube in place of the silver one was employed, and gradually shortened day by day till the wound closed.

Other sequelae of tracheotomy are bronchitis and broncho-pneumonia and the first signs of the development of these is often an alteration in the quantity and character of the secretion. The temperature also does not descend, as is usual, about the third day, but remains high, the pulse and respirations also continuing rapid.

Sub-Cutaneous Emphysema sometimes occurs. It appeared once in the series, affecting the neck and the upper part of the chest.

Lennox Browne⁽²⁰⁾ quotes Cadet de Gassicourt as stating that, the cases of broncho-pneumonia which get well are those which appear from five to eight days after the operation. Those which occur within two or three days usually terminate fatally.

In the case already detailed in which death resulted from pyo-pneumo thorax, it was on the evening of the second day after the operation that the temperature, pulse and respirations began to go up. On this day also the difficulty with the secretion began.

In these cases stimulants like whisky and strychnine are necessary and the ordinary expectorants may also be tried. Instead of steam and especially if, as often happens, the smell from the tube is bad, towels sprinkled with creosote are hung up in the tent, and the soda spray referred to, used. This should not be carried too far, only small quantities at a time being sprayed over and into the tube, and it should not be used too frequently.

In tracheotomy cases, the time chosen - in relation to the operation - for the injection of anti-toxin, is immaterial; it should be given as early as possible and one prefers to give a fair dose at once, viz., 8000 - 14000 units or more. It has been stated that⁽²¹⁾ if a sufficient interval be not allowed/

allowed between the injection of the serum and the operation, there is danger of the membrane being incompletely separated below and possibly later giving rise to difficulty of breathing, or even sudden death, by plugging the tube when it does separate.

That such an accident may happen is undoubted, but the writer of the article in question is hardly fair in throwing all the blame on antitoxin as, in the two cases which he quotes in support of his view, the accident occurred within four hours of the injection and the dose he administered was small - 2000 units. Also, it would appear from his description, that he did not look for or attempt to get rid of membrane at the time of operation, but contented himself with opening the trachea and introducing a tube.

About 24 hours after the injection, one believes to be the most anxious time and always warns the nurse to be especially on her guard, the membrane coming away very commonly at this period and not infrequently in pieces too large to pass the tube.

This risk is appreciated by nurses of experience and several have volunteered the information that/

that in nursing a tracheotomy case, the second night is the one they dread most for this very reason.

With regard to Intubation of the Larynx, one cannot, unfortunately, speak from personal experience. Those who employ this method of treatment speak highly of it, and it is noteworthy that many who were at first opposed to it, are now amongst its supporters and use it to the exclusion of, or as a preliminary to tracheotomy.

On two occasions one attempted to intubate, but both times failed and since then opportunity has been lacking. To introduce the tube, a considerable amount of dexterity is required and that dexterity can only be obtained as a result of practice.

Practice on the cadaver teaches the relation of the parts, but very little else, as there is so little resistance offered that the tube slips in fairly easily. Practice on the living patient is required and that is not easily obtained and one has always been unwilling to add further to the sufferings of the patient.

As early as 1858 Bouchut, according to Lennox Browne, who himself believes in the operation, recommended this method of relieving the dyspnoea but, to-day/

to-day, the name of O'Dwyer is most commonly used in connection with its introduction. Like everybody else, Lennox Browne advises one to be prepared for tracheotomy.

In a recent number of the British Medical Journal (22) there is an extract from a German paper on the subject, in which the writer, dissatisfied with a mortality of 51% from tracheotomy took to intubation. In all, he intubated 31 patients and his death rate was 25.8%. In 21 cases, he had to perform tracheotomy later so that thereafter, he determined to combine the methods, intubating first and then, after the mucus, etc., had been discharged, to open the trachea. By the combination he reduced his mortality to 23%.

The advantages claimed are:-

1. There need be no hurry with the tracheotomy.
2. The veins are not distended and there is less haemorrhage.
3. The hard tube in the trachea acts as a guide.

Without doubt, there is much to recommend intubation, and a treatment which is employed by men whose opinion is of the greatest value cannot be lightly criticised. One has several times seen the operation performed and admired the ease and rapidity/

rapidity with which the tube was introduced, what always struck one, however, was the risk of suffocating the child and the fact that tracheotomy had frequently to be resorted to in the end.

It is not a method likely ever to have much vogue in private practice, unless indeed, a nurse capable of replacing the tube could be found. There is, of course, not much risk of suffocation for some time after the tube is coughed out, but there is always some danger and that danger would have to be explained to parents, etc.

With tracheotomy, a good nurse can do a great deal and can very easily learn the management of the tubes.

Much is made of the necessity for several assistants in tracheotomy; in many of these cases two nurses only were present, one to assist with the instruments, etc., the other to swab.

P A R T I I .FAUCIAL AND OTHER FORMS OF DIPHTHERIA.

In dealing with the laryngeal form of the disease, one expressed the belief that the difficulty of diagnosis there was, in some cases at least, due to a misunderstanding as to the meaning of the word "Croup". In the faucial type it is different and all definitions of this form instead of being merely a statement of a series of symptoms, contain some reference to something - the false membrane - which can be seen and touched. This is recognised by everybody, even the laity, and practically in every case the diagnosis, at least partly, is made from the discovery of such a membrane.

Unfortunately/

Unfortunately, there are other conditions which lead to the production of a false membrane, or at any rate, to the production of an exudation which resembles a false membrane and the difficulty of diagnosis and the errors in diagnosis which occur, result usually from a failure to distinguish between a diphtheritic exudation and an exudation produced by some other cause.

Empis,⁽²⁾ writing of the exudations which have been mistaken for the membrane of true diphtheria says:- "If in a child at the breast, affected with enteritis, the mucous membrane of the mouth is seen covered with a whitish pseudo-membranous layer, it is diphtherite!! If an exhausted phthisical patient develop muquet on the tongue and mucous membrane of the mouth, it is Diphtherite! If in a patient with Scarlatina, the specific cause of the bucco-pharyngeal inflammation is seen to produce a plastic and pseudo-membranous exudation, it is still Diphtherite!"

To-day, we are not quite so bad, but it is at the same time true that to the diphtheria wards, more than to the other wards of the hospital, are cases sent labelled "probationary" or with a diagnosis which has to be altered after observation.

In/

In dealing with diagnosis these cases will be referred to again and in the meantime a definite path from the definition of the disease to the symptoms, diagnosis, prognosis and treatment might be followed.

A Definition to be a good one should be short and the few words employed should leave an impression on the mind of the outstanding features of the disease.

Lennox Browne's definition that: "Diphtheria is an infectious disease due to the presence of a specific micro-organism," is quite accurate, but it conveys very little information as to what the disease is like.

Goodall and Washbourn practically use the same words, but they extend their definition to include references to the symptoms and complications. Stated shortly, it amounts to this: Diphtheria is a disease due to the invasion of the body by a specific organism; at the seat of invasion, it leads to the production of a false membrane, while the substances it generates tend to act upon the nerves supplying various organs and tissues and may cause either death or temporary paralysis.

Lennox Browne's definition is undoubtedly far more/

more accurate and comprehensive, since it includes all these cases which, though they show no membrane formation, and it may be, no constitutional phenomena, are still diphtheria and as such are capable of giving rise to other cases. The second definition is, however, a serviceable one and escapes the charge of being a mere synopsis of the symptoms which takes the place of a definition in many books on "Fevers".

Clinically of course, it is practically impossible to diagnose a case of faucial diphtheria unless there be exudation present and in all the cases considered, which proved to be examples of that disease membrane was found. It is common enough to find that one or two persons in a house in which the disease exists, complain of sore throat and yet have fauces quite free from membrane. A bacteriological examination in such cases has lead in many cases to the discovery of the Klebs-Löffler bacillus and doubtless the persons were suffering from diphtheria in a mild form.

Such cases are rarely sent into hospital and busy practitioners when they find no membrane, regard them as instances of simple sore throat.

SYMPTOMS:

The incubation period of diphtheria is recognised by all as short, but in the majority of cases it is practically impossible to fix its duration. By common consent 1 - 7 days has been taken as the period in cases in which infection is acquired in the ordinary way; Lennox Browne puts it at 1 - 4 and states that, when acquired as a result of direct contact, it is shorter.

In hospital cases it is not often possible to determine what it may be, either among the patients admitted or among members of the staff who take the disease; the former, because the class of patient admitted cannot give exact information, the latter, because they are practically all the time exposed to infection in one way or another.

The Prodromal Stage is also of doubtful and variable duration and very often it is difficult to fix its limits. In the majority of text-books, it is stated that the onset of diphtheria is gradual, that there is exceptionally, sickness and vomiting or shivering, the symptoms being more usually vague.

In the cases analysed here, special attention was given to this point, enquiry being made as to the/

the nature and duration of the symptoms which lead the patient to take medical advice. In 37%, there was no prodromal stage at all, the onset being more or less sudden with headache, sore throat, sickness or shivering. In the remaining 63, there was what might be regarded as a prodromal period lasting on the average one day and characterized mainly by a feeling of malaise.

One of the most striking features is the rarity with which sore throat was complained of. In 35% of the cases only, was it mentioned; in 15, it was the only symptom, in the remainder, it was associated with shivering, headache, sickness or all three.

In 23% headache, in 32% sickness and in 16% shivering, alone or combined with the others was present at the onset.

Shivering was most commonly complained of by those over 10; in those younger, it appeared seldom as is the case in nearly all acute disorders in children. Convulsions, which in these sometimes takes the place of shivering, did not occur.

In the case of young children, one found it sometimes stated that the child was troubled with a "cold in the head". The discharge from the nose in these cases was nearly always due to involvement of the/

the nasal mucous membrane in the diphtheritic process.

A symptom not infrequently complained of by adults is pain and stiffness at the back of the neck, appearing before attention is called to the throat. It is by no means always present, but it may be found to have existed if enquiry be made.

The Headache which occurs sometimes is not at all characteristic.

The fact that Sickness occurred and was complained of so comparatively frequently is of interest when one remembers that there is a tendency in many minds to consider that the onset of diphtheria is hardly at all accompanied by this symptom.

Indeed, the opinion that a sudden onset is incompatible with diphtheria is not at all uncommon, such being considered to be suggestive rather of some condition like Follicular Tonsillitis.

Diarrhoea at the onset was only in two cases complained of and was in all probability due to some other cause.

The early Sore Throat of diphtheria is said by Lennox Browne⁽³⁾ and others to differ from that produced by tonsillitis from other causes, absence of pain on swallowing and on opening the mouth, being especially characteristic. In adults, one often heard/

heard complaint made of a feeling of dryness and tickling in the throat and though there was frequently absence of pain on swallowing, yet it cannot be said that this was always the case.

Children also sometimes cry on swallowing. It is remarkable, however, how little pain is complained of by these, even when the tonsils are greatly enlarged. In Scarlet Fever, one has noticed this same absence of discomfort even with fauces deeply congested or in anginous cases when the enlargement was marked.

In ordinary cases, there is generally very little pain on opening the mouth, but in the more severe cases and especially in those where there is distinct enlargement of the glands of the neck, pain may be present.

Feverishness is sometimes complained of and Delirium at the onset may occur, although one has not very often noticed it.

Within a few hours of the onset, the appearance of the patient may lead to a suspicion of what the disease is. Depression is distinctly a feature and if not absolutely compelled to take to bed, the patient feels so weak that he is disinclined to move about. Pallor, though not invariably present is often distinct and that too in cases not very severe in which the waxy pallor is characteristic.

In/

In some cases of Scarlet Fever associated with Diphtheria, one has been led to suspect the presence of the latter by the appearance of the patient alone.

In persons of a florid complexion, the pallor is less marked, but there is always some change in the appearance, the eyes being sunken and dark ringed.

The temperature is usually elevated; when the onset has been gradual, it may reach 99° or 100° F. If sudden, 101° - 103° or even higher. The pulse too, is quicker, but the special characters will be considered later.

On examining the throat at this stage, congestion of the fauces is generally found and the tonsils may or may not be enlarged. Exudation may be in considerable amount, the rapidity with which it forms after a sudden onset being remarkable.

The Foetor so characteristic of diphtheria may be present, even although there is only a minute trace of exudation. This smell when present is almost, one is inclined to think, conclusive of diphtheria. It is revolting and lingering and suggests organic matter in the last stages of decay. Once smelt it cannot be forgotten; it was distinctly present in 33% of these cases.

Enlargement of the glands at the angles of the jaws when present appears early.

The further developments depend upon the type of the disease and the types described are, Mild, Moderately Severe, Severe or Malignant, and Haemorrhagic.

In the Haemorrhagic Type there is in addition to bleeding from the nose, which may occur in ordinary cases, haemorrhage into the skin and from the mucous membranes. This type is fortunately rare; it is almost invariably fatal and corresponds to the Haemorrhagic type of Scarlet Fever, or of Smallpox.

The Malignant Type is also rare; in it the constitutional symptoms are those most marked and though usually the throat is thickly coated with membrane and the nose too is involved, it is not always so. Just as in Scarlatina Maligna, the patient may be killed by the poison before the rash has time to develop distinctly and the throat to be affected to any extent, so here the patient may die before there is much membrane formation.

The present series contains four examples of this type and it might be convenient to describe these now, and to give later a description of the other types in the series with the notes of any specially interesting.

Two of the four malignant cases were males and two were females. The males were aged, respectively 6 years and 24 years, and both died. One of the females was 8 years of age and the other 31 and they also both died.

The first case to be admitted was the man aged 24.

For four days before admission, he had been complaining of sore throat and of pains all over his body and had been treated for rheumatism, but had grown steadily worse.

On admission, he was in a collapsed condition. The face was white and drawn, the breathing was rapid but regular, the pulse also was regular but very small and feeble, 170 per minute. He appeared drowsy and was difficult to rouse; he would give no information as to the origin of his illness and when asked concerning pain, pointed to the neck and upper part of the chest. The temperature was 106.2° F. in the axilla.

The tongue was slightly furred. The tonsils were both enlarged. The left was clean, but the right showed a dirty white exudation.

Examination of the chest was negative; the heart sounds were feeble and indistinct.

Antitoxin/

Antitoxin, 3000 units, was injected, stimulants were administered, a cold sponge ordered and the temperature fell to 104.8° . The patient did not rally, but gradually became worse and two hours after he was admitted the temperature reached 107° F. The pulse was practically uncountable, the face greyish yellow and the patient unconscious; 40 minutes later he died, less than three hours after admission.

A swab taken from the throat gave practically a pure culture of Klebs-Löffler bacilli.

Post mortem examination disclosed slight congestion of the lungs and slight enlargement of the spleen.

The second patient was a boy of 6 and the case presented features entirely different from the first. He lived for a few days after admission.

The onset was sudden with sickness, vomiting, headache and sore throat, three days before admission.

When admitted, there was marked waxy pallor. The teeth were covered with sordes and there was a great deal of discharge from the nose. He breathed entirely through his mouth, and, as is often the case when the nose is affected, the foetor was overpowering/

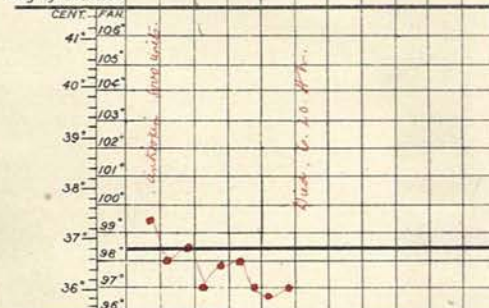
Very Severe or Malignant Diphtheria

Records of Temperature, Pulse, Respiration,

In the case of Joseph Allan. 6

Day of Month. 20 21 22 23 24 Dec. 1910.

Day of Disease



Pulse.	116	117	113	110	113
Resp.	24	20	22	20	18
Stools.					
Urine.	alb	alb	alb	alb	alb

YOUNG J. PENT

overpowering. The glands of the neck were greatly enlarged and the tissues around infiltrated and swollen, producing the condition known as "bull-neck".

The mouth could only be opened with difficulty. The tonsils and fauces were greatly swollen and thickly coated with a dirty membrane blackened by altered blood. In their enlargement, the tonsils had displaced the uvula, which was pushed back and concealed from view. The temperature was 99.4° F., the pulse 118, and very feeble, but regular. The boy was obviously very weak, but complained of no pain. The urine was albuminous.

Bacteriological examination of the membrane showed bacilli.

Immediately on admission 8000 units antitoxin were injected and whisky and strychnine were to be given every four hours. For local treatment, the throat and nose were to be syringed every three hours with diluted sanitas; hot fomentations were to be applied to the neck.

Next day, there was very little change; the nasal discharge continued. The left tonsil and anterior pillar looked slightly cleaner. The foetor, however, was still very marked and screens hung with towels sprinkled with equal parts Formaline, Glycerine and Water were erected round the head of the bed.

The/

The second morning after admission there seemed to be slight improvement. The neck was less swollen, the faucial congestion was less and the membrane was showing signs of disappearing. The smell was still very foul. Later in the day the nose started to bleed, but ceased after a time.

The boy passed a very bad night; the nose bleeding recommenced and he was very restless. In the morning the neck seemed to be less swollen and he could open his mouth better, but the exudation was still very considerable. He complained several times of thirst, but otherwise paid little heed to what was going on. The Formaline was removed. All day and all night a copious sanious discharge continued to flow from both nostrils. The pulse was much weaker, the temperature subnormal and the urine, much diminished in amount, was loaded with albumin.

The tonsils were now quite clean, but congested and unhealthy looking. At 10 p.m., that (the 4th) night, it was noted that the discharge had been lessened by syringing with very hot boric lotion and that the boy seemed easier.

About 1 a.m. the discharge ceased and the patient slept fairly quietly. At 5, he awoke and had whisky and strychnine and went to sleep again. At/

At 6.15 he awoke, started up in bed and cried out for a drink; before the nurse could reach him, however, he had dropped back dead.

At the post-mortem examination the heart was found dilated, the right side being distended with pale clot. Otherwise, there was nothing of note.

All the symptoms in this case marked it from the first as a severe one and though one at one time thought, on account of the marked epistaxis, that it might be an example of the haemorrhagic type, it much more probably fell into the malignant group.

Undoubtedly, the treatment should have included the daily administration of 6000 or 8000 units antitoxin, and one still regrets that that was not done.

Of the other two cases, the condition of the throat in the adult female more resembled that found in the man, so far as exudation was concerned, but the tonsillar enlargement was more marked and the glands in the neck and the other tissues there much more infiltrated.

The onset had been gradual and the pallor was extreme. A swab from the throat showed bacilli in abundance.

The/

The temperature on admission was 103.6° F., the pulse 124 per minute and the urine showed albumin. The breathing too, was rapid - 28 per minute - and examination of the chest revealed a left lower lobe pneumonia.

Antitoxine 6000 units was injected and stimulation kept up all night. The patient, however, grew continuously worse and died early the next day.

Case IV., turned ill with sore throat five days before admission and the day following the death of a younger sister from diphtheria.

Local treatment only was employed till the fifth day, when the child having become steadily worse, it was thought that possibly tracheotomy might be necessary and the child was sent to hospital.

On admission, the girl was quite collapsed and white, but there was no indication for operation. The pulse was imperceptible and the heart sounds very rapid and faint.

The smell from the throat was very foul; the fauces and tonsils were greatly swollen and covered with a curtain of almost black membrane.

The neck glands were much swollen. At once, 12000 units of antitoxin were given; whisky, strychnine/

strychnine and ether were repeatedly administered, but within an hour the child was dead.

It struck one that it was a pity, seeing the diagnosis was clear from the commencement, that antitoxin was not given at first, but there are still members of the profession who, for one reason or another, abstain from using it. Fortunately, the serum and its value are becoming known to the laity and in many cases an injection is requested.

The details given render any further description of the malignant type practically unnecessary. In them all, the usual symptoms are exaggerated and, with the exception perhaps of those cases in which membrane formation is not marked, the diagnosis is fairly easy.

THE MILD AND MODERATELY SEVERE TYPE.

Practically all the remaining cases fall into the latter group, the symptoms in some though serious, being scarcely severe enough to justify their inclusion in the malignant group, and in others not sufficiently mild to make them of the mild type.

The symptoms regarded as typical of the moderately severe or ordinary type of Diphtheria might be stated as follows:- An onset gradual, not infrequently sudden, characterised by increasing debility and sore throat, or headache, sore throat, sickness and shivering. Facial pallor, feverishness, rapid soft pulse, and albuminuria. Exudation on the tonsils or tonsils and fauces and enlargement of the cervical glands.

Of these symptoms reference has already been made to the importance of the exudation. The other signs and symptoms are accessory and very valuable as aids to diagnosis, but their value varies and it might be advisable to take each symptom or sign by itself, consider it and assess its value by finding how often it appeared in the series.

The character of the onset has been already more or less fully considered but it may be mentioned here that a feature which has frequently struck one about these cases is the alteration in the quality of the voice the patient talking as if the mouth were full even when the tonsils are very slightly enlarged.

CONDITION OF THE FAUCES AND DISTRIBUTION OF THE
MEMBRANE:

In nearly every case of the series there was congestion of the fauces but enlargement of the tonsils was by no means always present. Sometimes they could be seen red and inflamed, their surface either flush with the free borders of the faucial pillars or distinctly below or above them.

When greater enlargement takes place one gland may jut out from between the pillars reaching to or beyond the middle line, carrying the uvula with it. In other cases the uvula is found bent upon itself, its tip adhering to the unaffected tonsil.

When both tonsils enlarge, they may meet in the middle line and as a result the uvula may be pushed back and hidden from view. In these cases the opposed surfaces may be quite flattened and when in examination the spatula is pushed well back into the mouth, the tonsils separate, opening up like a book or like a two-leaved screen to show the flat inner surfaces. This condition has been mostly noted in persons already the subjects of chronically enlarged tonsils.

Sometimes/

Sometimes it would almost seem that the tonsil in enlarging carries the anterior pillar along with it; this appearance is produced in cases in which congestion and oedema are marked, the swelling of the fauces keeping pace with that of the tonsils.

A striking feature in all these cases is the readiness with which the congested tissues bleed, the slightest touch leading to haemorrhage. The discovery of blood upon the swab taken for bacteriological examination tells rather in favour of, than against, diphtheria, other forms of sore throat, e.g., Scarlatinal, bleeding much less readily.

THE FALSE MEMBRANE.

Membrane usually appears first on the tonsils, hardly ever is its earliest appearance on the soft palate. It may occur as a thin bluish white pellicle over the whole tonsillar surface; it may occur as a ring round the tonsil, or it may appear between the tonsil and the anterior surface of the posterior pillar; sometimes it occurs as small points here and there over the surface of the gland.

It may show on one tonsil alone at first or on both together; on one tonsil it may appear in one way on the other in another.

Once formed, it may or may not spread. The spread/

spread may be limited to extension over the surface of the tonsil, the small points increasing in size and finally coalescing, or the ring round the edge may grow in towards the centre and completely cover the surface. Spread may not, however, take place to any extent from the separate points, each patch enlarging slightly, but never joining the others. In a case one saw recently in which the larynx became secondarily involved after three days, the whole tonsillar affection was represented by two patches on the right and three on the left tonsil, each patch perfectly round and well defined and none larger than a small split pea.

Spread may take place to the soft palate, affecting the posterior surface of the pillars or of the uvula, appearing round the edge of the uvula, or between it and the pillar. The appearance of the membrane at the edge of the uvula is, according to Lennox Browne, to be taken as an indication that the whole posterior surface is covered, as can be demonstrated by lifting up the uvula with the spatula.

The posterior pillar may be involved and in all cases where there is exudation on the tonsils, an attempt should be made to see the posterior surface/

face of this as well as of the anterior pillar and the uvula. The membrane may extend forward along the gums and cheeks.

It may extend backwards and affect the pharyngeal wall and upwards to affect the nose, membrane being deposited in the posterior nares - very uncommonly in the anterior nares - and leading to a discharge irritating, serous, sero-purulent or sanguineous. From the pharynx it may spread up the eustachian tubes to the middle ear; from the nose it may spread through the nasal ducts to the conjunctiva.

Downwards, spread may occur to the larynx and trachea.

In the 100 cases dealt with, the membrane was distributed as follows:-

- In 61 instances the exudation was limited to the tonsils.
- In 27 of the cases the fauces were, to a greater or less extent, involved along with the tonsils.
- In 5 the tonsils, fauces and nose were involved together.
- In 4 the fauces escaped, the tonsils and nose being affected.
- In 2 cases the pharynx was attacked once, when the tonsils and fauces were involved, and once in association with those and the nasal mucous membrane.
- In 1 case spread took place to the buccal mucous membrane from the tonsils and fauces.

In the 61 cases in which the tonsils alone were affected, the exudation was found only on one gland in 23 instances. When both tonsils were involved it was noted several times that one was more affected than the other, one side showing a few discrete patches while the other was closely invested.

The character of the exudate also sometimes differed being soft and pultaceous on one side while on the other it was tough and adherent.

The membrane varies in Colour and Consistence. At first generally white or bluish white, it may pass through yellowish and greenish shades to be almost black, the changes in colour being due, in some cases, to altered blood.

In consistence it may be quite soft and readily rubbed off giving the appearance as Lennox Browne terms it of having been "plastered on". This form is sometimes found between the tonsil and the pillars, it is usually yellowish white in colour, seems to consist almost entirely of organisms and may be mistaken, when seen on a swab, for a morsel of half chewed bread which has been lingering about the fauces!

In the early stages the false membrane may be easily removed, it is then found to be tough and translucent/

translucent, and may be fairly easily teased. Later it becomes thicker and tougher and less easy to detach. When spread has taken place to the uvula and soft palate the membrane affecting these parts soon becomes thick and tough and becoming greenish in colour produces the "wash leather" appearance. To the pillars and uvula the membrane may be firmly adherent but, not infrequently, it hangs loose like a curtain in front of the fauces.

The tough cast of the uvula closely resembling the tip of a glove-finger-as pointed out by Trousseau and Guersant - is frequently seen and easily recognised.

The Foetor mentioned before is more marked when the membrane is considerable, when the nasal mucous membrane is badly involved its intensity is very greatly increased.

BACTERIOLOGY.

As a matter of routine a bacteriological examination is made in all cases admitted to the diphtheria wards, swabs are taken from the throat and films made and stained by Gram's method if the signs and symptoms point to the cases being undoubtedly diphtheria. If there is any doubt as to/
to/

to the diagnosis cultures on blood serum are made. In all these cases, with the exception of 11 when one was so situated that an examination could not be made, such a course was followed and the diagnosis confirmed by the discovery of the Klebs-Löffler bacillus. In the 11 cases excepted one felt sure of the diagnosis from the clinical features. It may be mentioned in passing that antitoxin is employed always on the strength of the clinical diagnosis without waiting for the result of the bacteriological examination.

Adenitis is a very common feature of faucial diphtheria and is of considerable diagnostic importance. The glands at the angles of the jaws are those usually affected and almost instinctively one feels for evidence of their enlargement before or after examining a throat. The submaxillary glands are less often involved.

Associated with the enlargement there may or may not be tenderness on palpation. Usually both sides are affected even when only one tonsil is involved, the affection is rarely equal on the two sides and the side with the more markedly enlarged glands is not always the side on which the tonsillar affection is more distinct.

In children the glandular affection is, as a rule, more intense than in adults and an amount of exudation which in a child gives distinct enlargement may in an adult produce no effect.

In severe cases the infiltration may be very marked producing a visible tumour and when - as in some of the malignant cases already described - the other tissues are involved the neck may be considerably swollen.

Suppuration may occur at a later period - Lennox Browne found it in 9.75% of his 1000 cases - but generally as the throat clears the glands begin to subside.

Secondary adenitis will be referred to later. Infiltration of the glands was present to a greater or less extent in 91% of the cases examined; of those who presented no palpable enlargement only one was under five years of age, five were between 9 and 15, and two were over 20 years of age.

Unfortunately other throat affections are frequently associated with enlargement of the glands of the neck which diminishes somewhat the value of this sign in diphtheria. In Scarlet Fever, for instance, there is almost invariably this increase in size and when, as sometimes happens, the two diseases occur together very little help is to be got from the condition of the glands in differentiating them.

ALBUMINURIA/

ALBUMINURIA.

Opinions as to the value of the presence of albumin in the urine, as a diagnostic sign, vary. Lennox Browne,⁽⁴⁾ while admitting that it may be present in about a third of the cases, does not consider that its discovery, in a doubtful case, gives very much help in arriving at a conclusion, since it is found also in the urine of persons suffering from other non-diphtherial inflammations.

Goodall and Washbourn⁽⁵⁾ on the other hand think that, as albumin is to be found in as many as three quarters - rarely in less than a quarter - of the cases, it ought to be considered as a symptom and this is the view held by most observers and stated in most text-books of medicine.

The opinion held in the Edinburgh City Fever Hospital is - or was some years ago - that the presence of albumin in the urine of a person with a membranous condition of the throat is very strong evidence in favour of the throat condition being diphtherial in origin.

After subtracting from the series the cases in which no examination was made on account of the difficulty of obtaining a specimen albuminuria was present in 42% of the 143 cases.

The/

The quantity of albumin varies very much, appearing sometimes only as a trace or as a faint cloud when the urine is heated, in other instances a distinct precipitate may be produced.

Usually, according to Goodall & Washbourn, it appears about the fourth day and its appearance is rarely postponed beyond the end of the first week.

In the most severe cases it appears earliest, sometimes even on the first day, and is greatest in amount.

In this series the average day for the first appearance was the fifth, in some it showed itself on the second day and in others not till the ninth or even later.

Personally one is inclined to agree with Goodall and Washbourn and one always feels more certain of the diagnosis when albumin is present.

From the Pulse in diphtheria, as in Typhoid Fever and Scarlet Fever, great assistance may be obtained in arriving at a diagnosis.

In Scarlatina the pulse is rapid out of proportion sometimes to the temperature and is full and generally strong. In diphtheria there is this same want of proportion but to even a greater extent and it is soft and of low tension and, it may be, dicrotic.

In/

In children this phenomenon is most marked and quite frequently in patients of four or five one finds a pulse rate considerably over 100 per minute while the temperature is normal or at least under 100° F., e.g., two cases at random, a female age 5 on the third day, pulse 120, temperature 98.2° F., and a male of the same age on the same day pulse 118, temperature 98° F.

In patients over 13 this is not so marked but even in these with an average temperature of 100.8° F. the pulse beats numbered over 100 per minute.

In children under 13 the average rate was 120 and the average temperature 100.2° F.

This rapidity of pulse usually continues during the whole time there is exudation present and for some days after the throat is clean. In the ordinary course of events - it would seem from these cases - the pulse rate goes on gradually diminishing in rapidity till the normal rate is reached, generally about the end of the second week of illness. In a certain number, however, this is not the case, the pulse continuing rapid for, it may be, many weeks after all sign of disease is gone. In one case of this series - a girl of 5 - at the end of the ninth week of illness the pulse varied from 106 in the morning/

to show variations on pulse rate. Result - Recovering

Records of Temperature, Pulse, Respiration, Stools and Urine, from Day of 18

In the case of John Ferguson Aged 22 Occupation Wine Weaver

[illegible]

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morning to 110 in the evening, though the child was apparently quite well and the temperature normal. In another case one saw in outside practice the same conditions prevailed.

In yet other cases the pulse before coming to the normal falls to below 60 or even 50 beats per minute during the latter half of the second week and continuing so for several days -a week or longer- gradually rises to between 70 and 80.

This phenomenon was observed in 15 of the present series.

Variations in regularity are of course common in diphtheria and are most usually noticed during the first two weeks and especially in the night or early hours of the morning.

All these are evidences of the effect of the diphtheria toxine on the innervation of the heart, but to thoroughly appreciate the power of the poison on this organ, it is only necessary once to see a patient who was apparently doing well suddenly drop back dead.

Apart from sudden paralysis, tachycardia brady-cardia and irregularity of the heart, another condition produced by this same toxine may appear during convalescence and greatly delay its progress, viz/

viz., attacks of faintness and palpitation. In one case such attacks commenced four weeks after all symptoms had disappeared and occurred at intervals for nearly three weeks, disappearing as the strength increased.

THE TEMPERATURE:

At the onset of the disease there is usually a certain amount of fever although it may only be represented by a rise of one or two degrees above the normal. It is very well known now that there is very little relation between the severity of the fever and the severity of the disease, indeed in the worst type of cases the temperature may be quite subnormal.

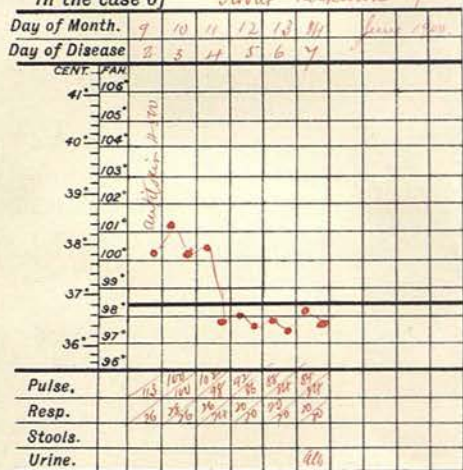
The present analysis would almost seem to show that the character of the onset has little effect upon the temperature and a patient whose illness is ushered in with shivering, sickness and vomiting may have no more fever than one becoming more gradually ill.

Lennox Browne⁽⁶⁾ found in the 1000 cases which he analysed that in 50% the temperature was below 99° F. and in 80% it was over 101° the cases coming, on the average, under treatment on the third day.

All/

Records of Temperature, Pulse, Respirat.

In the case of *Robert Kirkwood 4*



YOUNG J. P.

All over, the average in the present analysis was 100.5° F. adults being much the same as children.

Among those admitted on the second, and third days it was 100.2° F. On the fourth day the average temperature on admission was 97° F. In 26% of all the cases the temperature was 99° F. or under, in the remainder, it was over 99° , in 24%, it was 101° or over. The lowest temperature on admission was 97° F. the highest 106° ; as in Lennox Browne's cases, the patients on the average were admitted on the third day.

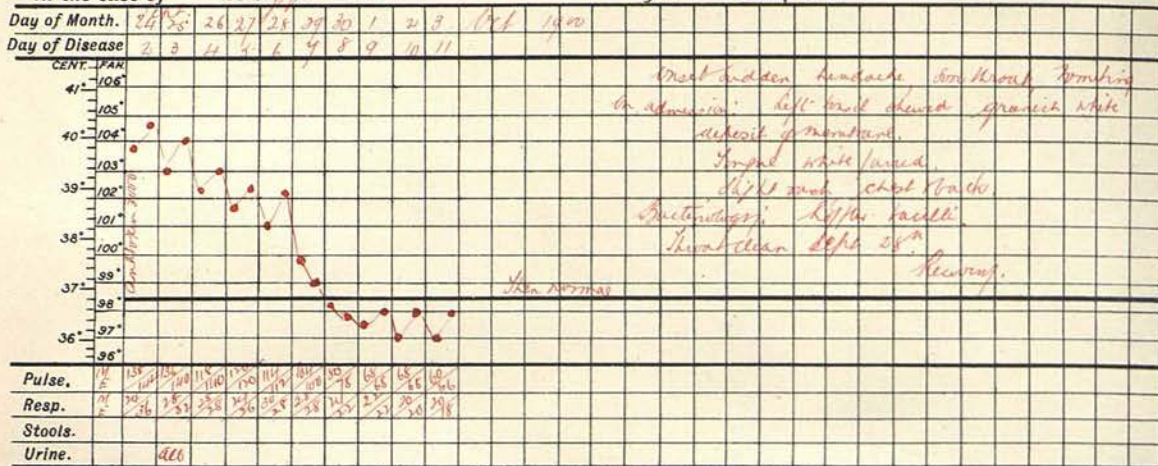
The average duration of fever was three days the termination being either by a sudden drop or by a more gradual fall lasting two or three days.

The reduction of temperature, one is inclined to think, is in many cases directly due to the antitoxin administered for one finds that after injecting the serum in other-non-diphtheritic e.g., Scarlatinal - throat conditions a fall of temperature almost always occurs. This same phenomenon has been noticed by others.

During its course the temperature may be interfered with by complications e.g., Secondary sore throat or adenitis, when there may be a distinct rise/

in case of Diphtheria with Scarlet Fever

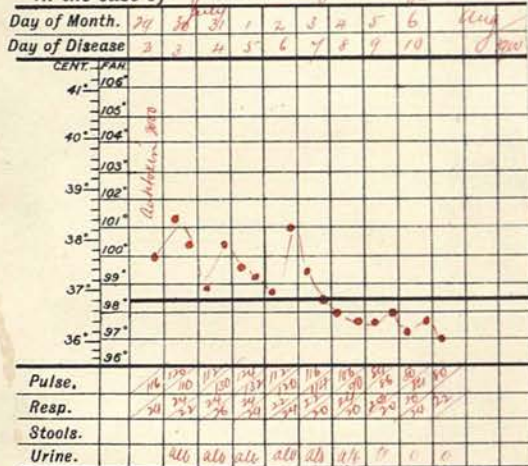
Records of Temperature, Pulse, Respiration, Stools and Urine, from Day of 18
In the case of *Maggu Lee* Aged *8* Occupation *Hand maid*



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in
Records of Temperature, Pulse, Respiration, &

In the case of *Sarah Givier*, Age *6*



YOUNG J. PENTLAND

rise. When paralysis occurs there is rarely any alteration in the temperature though it may rise slightly.

The occurrence of anuria may be diagnosed by a fall of temperature.

When associated with some other acute disease e.g., Pneumonia, Scarlet Fever or Measles, the fever is almost always characteristic of that other disease. With Scarlet Fever this^{is} especially noticeable and now, when one finds a temperature coming down by a lysis lasting five or six days, one begins very carefully to look for signs of desquamation.

It is difficult to say what value is to be placed upon the temperature as an aid in arriving at a diagnosis. It is mainly in differentiating between Diphtheria and Follicular tonsillitis that help is to be obtained and the statement made by Foord-Caiger⁽⁷⁾ that in the latter the temperature is likely to be higher may be taken as true to a certain extent.

Of cases presenting the most typical combination of symptoms possible, viz., a throat showing a diphtheritic exudation with, in association, albuminuria and adenitis there were 29, and in these the average temperature was 100.6° F. the average pulse/

pulse rate being 114 per minute. In nearly 70% of these the temperature was 100° or over, in 89% it was over 99° . In 58 cases in which albuminuria alone was absent the temperature was 99.6° and the pulse rate 112 per minute. In 50% of these it was over 100° , in 81% it was over 99° .

These figures and indeed all those connected with this subject would certainly seem to suggest that the temperature, in pure diphtheria, does not tend to rise very high. To get the greatest value from it, however, it has to be compared with the pulse rate and one is inclined to think that a temperature slightly over 100° associated with a soft pulse distinctly over 100 is more or less characteristic of this disease.

THE CONDITION OF THE DEEP REFLEXES:

Considerable importance is attached to absence of the knee jerk in cases of diphtheria by some, and Lennox Browne⁽⁸⁾ instances a case in which diagnosis was almost entirely made on this feature alone. The first reference, it appears was made to it by Dr. Macdonnell in America⁽⁹⁾ and at present, one is lead to understand, it is a routine part of the examination in some of the English Fever Hospitals. Dr Tirard⁽¹⁰⁾ refers to it and says it ought to be sought for in every case.

In/

In this school very little attention is paid to it as a sign. In several cases which one examined the main difficulty one had was in determining that it really was absent and not apparently only because one had failed to elicit it. In children especially one had great difficulty in being sure and after a time one gave up searching for the reflex at all.

DIFFERENTIAL DIAGNOSIS:

The principal throat affections with which one has seen faucial diphtheria confounded are:-

1. Tonsillitis,
Follicular; Simple rheumatic;
Suppurative.
2. Scarlatinal Sore Throat.
3. The sore throat of measles.
4. Ulceration of the pharyngeal wall.
5. Syphilis of the fauces.

It is usual also to consider, Herpes, Thrush, and tuberculous ulceration of the fauces when dealing with the diagnosis.

Of the three types of tonsillitis the Follicular form - especially the septic type - is the most difficult to distinguish, and working in a hospital/

hospital one is often called upon to make up one's mind whether a sore throat with a patchy exudation in a new member of the staff is merely the result of "hospital sore-throat" or is really diphtheria.

The feeling one has - and it may be right or wrong - is that the discovery of exudation at once biases the mind in favour of diphtheria, and the help to be obtained from associated symptoms is disregarded, and even that the characters of the exudation are not gone into.

In follicular tonsillitis the appearance of the tonsils and fauces may be quite characteristic but at other times may have a distinct resemblance to the more serious condition.

Usually there is marked congestion of the whole fauces, they may be dark red or claret coloured and shining. The tonsils are usually enlarged and one or both shows exudation.

Typically the exudation is localised to the follicles which are distended, some greatly others to a less extent and the whole, or only part of the surface, of the gland, appears speckled with yellowish white spots varying in size up to a small split pea. The plug may protrude from the mouth of the follicle distinctly rounded and raised above the surface of the tonsil. This is a feature to be borne in mind.

Later/

Later, very frequently over part, less commonly the whole of the tonsil, the exudation runs together and a membrane like appearance is produced and, as this increases, the diagnosis becomes correspondingly difficult.

The symptoms associated are, pain in the throat radiating sometimes to the ears and increased on swallowing or opening the mouth.

The onset has usually been sudden with headache, shivering, feverishness and very possibly sickness.

The temperature is raised, it may be, above 100° F. the pulse is increased in frequency, the face is flushed and very frequently there is enlargement and tenderness of the glands at the angles of the jaws.

Brought face to face with such conditions the problem is to discover whether we are dealing with diphtheria or not.

In treating of this subject the majority of textbooks point out as distinctive features that the material on the tonsils is limited to the follicles, that the glands are not enlarged, that there is no albuminuria, that the onset is more sudden the fever higher and the pain in the throat more marked. The knee jerk is also said to remain unaffected.

Unfortunately/

Unfortunately these features vary both in diphtheria and follicular tonsillitis; the following are points of interest and one has found them helpful at times.

1. Cases of Follicular Tonsillitis are very obviously acute, at least so far as the throat is concerned; there is redness, swelling and congestion of the whole fauces.

It is no uncommon thing to find in diphtheria considerable swelling with not very great redness.

2. Pain when present is usually more marked than in Diphtheria, more especially the darting pains up into the ears. Pain on opening the mouth is more likely to be present.

The amount of pain is not so likely to be trivial in comparison with the amount of congestion as is the case in diphtheria.

3. At first at least the follicles are blocked and distended and raised above the surface of the tonsil. Sometimes diphtheria affects the follicles either as Lacunar Diphtheria or as an exudation around a follicle. The first type generally occurs in persons the subjects of Chronic Tonsillar enlargement and one has noticed it especially in cases in which the tonsils met in the middle line. The exudate may hang out of the greatly distended lacunae or it may be quite inside the follicle.

When it is around the follicle it is spread out and looks flatter and not unlike the head of a nail. When the follicle ruptures in follicular tonsillitis the material appears heaped up and this same appearance of irregular heaping up may be evident when there has been spread over the surface.

4. The voice in Diphtheria is earlier and more markedly affected in proportion to the tonsillar enlargement.
5. The tonsils in Follicular Tonsillitis bleed less easily when an attempt is made to remove the exudate and though at times it may come away fairly easily it may be fairly firmly adherent especially in the septic type.
6. Usually only the tonsils are involved in Follicular Tonsillitis although one or two plugged follicles may be seen on the posterior pharyngeal wall.
7. Foetor is absent.
8. The pulse as a rule is stronger and more distinctly proportionate to the fever and the temperature may or may not be at a higher level than in diphtheria.
9. Glandular enlargement is not so distinct.
10. The face is more likely to be flushed.

The possibility of exposure to the infection of diphtheria must be carefully considered.

When the folliculitis results from exposure to insanitary conditions or when it occurs in persons working in hospital wards - especially infectious wards - the difficulty of diagnosis is greater.

In these cases the exudate is much more liable to extend all over the tonsil and the glands to be enlarged. The onset is usually sudden, the tongue is dirty, the temperature high and the pulse correspondingly rapid.

The faucial engorgement is considerable but the exudation/

exudation does not extend to the uvula and pillars.

The exudation is generally fairly firmly adherent and even sunk into the substance of the tonsil, it is to be noted, however that, though a bleeding surface may be left behind, the tissues do not so readily bleed as a result of the manipulations with the swab.

SIMPLE TONSILLITIS:

The only form of diphtheria for which simple tonsillitis is likely to be mistaken is that form in which there is no membrane formation. The necessity for distinguishing these is only likely to arise when sore throats occur in infected households or in the presence of an epidemic, but the mistake may occur apart from such circumstances.

SUPPURATIVE TONSILLITIS:

This should not give much difficulty but cases now and then are admitted suffering from this form of angina diagnosed as diphtheria. The mistake arises, in some instances at least, from the observer mistaking pus exuding from the follicles for a deposit in them. Palpation of the tonsils is of the greatest value and quickly cleared away all doubt in the cases one has seen.

The history of previous attacks may be of help.

Diphtheria/

Diphtheria is rarely associated with the formation of pus in the Tonsil - it only appeared once in the series - but the possibility of such an occurrence must be borne in mind.

The symptoms in these cases are characteristic, the swollen neck, the locked condition of the jaws, the salivation - as Lennox Browne puts it, Diphtheria is a "drier" disease - the intense redness and swelling of the fauces and tonsils, the agony on swallowing and the rapid firm pulse are all features more likely to be found in this disease than in diphtheria.

The throat condition in some of the other infectious diseases, e.g., Scarlet Fever, Measles and Typhoid Fever may have to be distinguished and as the two former may be associated with diphtheria it is sometimes difficult to arrive at an accurate conclusion.

Ordinarily the throat affection of Scarlet Fever is not at all like that of Diphtheria being deeply red, congested and glazed and not infrequently papillation may be noted on the hard and soft palates not unlike that found on the tongue at the "strawberry" stage. Usually there is no exudation, at times, however, there is exudation present, it may/

may be, in the form of a folliculitis, as a whitish pultaceous deposit, or as a more definite membrane-like coating to the tonsil, resembling that found in "septic sore throat".

In these circumstances it may have to be determined - especially if there is a rash present - whether the condition to be dealt with is scarlet fever or diphtheria or both combined.

It is much more common for Scarlatina to be mistaken for Diphtheria than for Diphtheria to be mistaken for Scarlatina for though rashes do sometimes occur in the former they are generally evanescent and easily distinguished from that of the latter disease. The exudation is generally the cause of the difficulty; when present as a folliculitis diagnosis is less troublesome but the soft pultaceous deposit or the membranous exudation are more easily confounded with the true diphtheritic membrane. Unfortunately as the symptoms of diphtheria are so liable to be overshadowed by those of any accompanying disease almost the entire dependence has to be placed upon the character and distribution of the false membrane.

In the case of the pultaceous deposit its limitation to the tonsils is to be noted and the fact that it is fairly/

fairly easily removed without leaving a raw surface. Often it has the appearance of being heaped up in one spot.

The other deposit more closely resembles a diphtheritic membrane in being fairly firmly adherent and in leaving a raw surface behind. It is limited to the tonsils and shows no tendency to spread to the uvula etc., it may cover the whole surface, is usually white and tough, and may be associated with the presence of small ulcers on the tonsils.

Pain is much more in proportion to the tonsillar enlargement than in diphtheria and the glandular enlargement more apt to involve the submaxillary glands and to be greater, one is inclined to think, than it would be in the latter disease with exudation so distinctly tonsillar in its distribution.

In Measles the throat conditions may be similar to those described under Scarlatina and the same precautions have to be taken to determine the possibility of the two diseases being associated.

Typhoid Fever sometimes begins with throat symptoms and there may possibly be exudation, as a whole, however, this is more rarely the case than in Scarlet Fever.

Herpes/

Herpes affecting the fauces is always mentioned as a condition which is to be distinguished from diphtheria though one has never seen the two diseases confused. If a mistake did occur it would probably be as a result of mistaking the resulting ulcers for patches of membrane. In all probability, as Goodall and Washbourn point out, help would be given in making a diagnosis by the discovery of herpes about the lips etc., herpes being exceedingly uncommon in Diphtheria. It was present affecting the lip in one case only.

Apthous patches may be mistaken for patches of membrane, as these are most frequently found in persons suffering from exhausting diseases and are rarely associated with acute symptoms it should be possible to exclude diphtheria.

The curdy nature of the deposit should be of assistance and also the fact that there is an absence of bleeding when this is removed.

The mucous patches of the Secondary Stage of Syphilis may be mistaken, especially as the glands are frequently enlarged at this period. The history in such a case - if obtainable - is of course invaluable and a search should be made for the primary sore. In the Tertiary Stage there may, in rare/

rare instances, be membrane formation which may lead to a diagnosis of Diphtheria, and one had the opportunity of seeing one such case. In this tertiary stage, ulcers, on account of their white bases, may be mistaken for exudation and the same mistake may be made in connection with other ulcers, tuberculous etc.

One case in which a diagnosis of diphtheria was made showed nothing but an ulcer of small size with a sloughy base on the pharyngeal wall. There were no other symptoms and the resemblance which this showed to diphtheria, when examined in a good light, was very superficial.

NASAL DIPHTHERIA:

Although the nasal mucous membrane is usually affected secondarily to the tonsils and fauces it may be attacked apart from these. The symptoms in the latter case are often so slight that no attention is paid to them till the fauces or larynx become involved.

In all cases of diphtheria it is wise to enquire after discharging noses in the household or amongst the patient's friends and help may be obtained, in making a diagnosis, from the discovery of such a condition.

The/

The main feature of nasal diphtheria is a discharge copious and irritating leading to excoriations about the nostrils and upper lip. Shreds of membrane may be discharged but membrane is not commonly deposited on the anterior nares.

In an ordinary coryza the discharge is not nearly so irritating nor is it quite so copious, and to distinguish nasal diphtheria from the snuffles of inherited syphilis there will be the other signs of specific mischief.

Nasal diphtheria shows a marked tendency to endure for a long time, and a long continued nasal discharge nearly always suggests diphtheria.

COMPLICATIONS AND SEQUELAE:

Convalescence from Diphtheria is, practically always, a very slow process, the patient being very weak and picking up very slowly. Fits of depression, the result of the weakness, are very common and children, even of an advanced age, often take fits of crying without being able to account for them; one has often been assured by adults that the stage of convalescence, on account of the associated weakness, was the worst part of the disease.

Apart from this the most serious and the most common complications are those the result of the action/

action of the diphtheria toxine upon the nervous system, there are however complications affecting the other systems of which the series contains examples and it might be well to take the systems in order.

COMPLICATIONS, ETC. AFFECTING THE ALIMENTARY SYSTEM.

After the membrane has disappeared from the throat redness may remain for some time and in all cases it is the rule to examine the fauces every few days for any evidence of recurrence of the exudation.

Apart from this recurrence there is a tendency to attacks of Secondary Sore Throat which may be either a simple inflammation or a more distinct folliculitis.

Quite frequently one found complaint of sore throat and on two occasions there was follicular tonsillitis. One occurred in the fifth week and the other in the third week after the original symptoms had disappeared, in both there was slight shivering at the onset with a rise of temperature but recovery followed in a day or two under local treatment.

The vomiting occurring at the onset has been referred to but apart from this it may appear later either/

either by itself or as a part of some other condition affecting the kidney or the heart, and its occurrence is to be taken as a hint to be on the look out for these. In the early stages it is of little moment, later it may assume serious proportions.

In the Respiratory System, Epitaxis may occur early in the disease or later, or as a part of a Haemorrhagic case. In severe cases, when the nose is involved, the discharge may be dark in colour as a result of admixture with blood. Of these cases six showed epistaxis which occurred in four during the first week and in two during the second week. There was evidence of nasal involvement in four of the cases.

Lennox Browne⁽¹¹⁾ regards it as a bad sign and states that the frequency with which it appears in cases dying of nephritis or anuria would indicate that there is something more than accident in the association.

In the one case of this series which died of anuria there was no epistaxis and in another in which the disease was associated with nephritis and in which death resulted from uraemia there was likewise no bleeding from the nose.

Affections/

Affections of the bronchi and lungs, except as a result of spread of the diphtheritic process to the larynx and trachea, are not at all common in faucial diphtheria. The only case in which there was pneumonia associated has been already referred to.

The main complications affecting the Heart are the result of the action of the toxine on its innervation. Tachycardia and bradycardia have been already mentioned.

Attention has been called (12) to the dilatation of the heart which is present, it is stated, in nearly every case of diphtheria. The writer of the article in question points out that so long as the left border of the heart is - in a child - less than a finger's breadth outside the left nipple line there is no danger, further out there is. Acute dilatation may occur very rapidly, increasing by a finger's breadth in 24 hours; it may appear at any time, early in the disease or up to two months, and is a frequent cause of sudden death. The heart muscle is degenerated and weakened and the slightest strain causes dilatation.

Another cause of sudden death from interference with the heart is to be found in the so-called Cardio-pulmonary/

Cardio-pulmonary seizures. This series contains no example of this condition and one is not aware of ever having seen one, they are referred to - not by name, by Goodall and Washbourn as occurring in cases in which paralysis is widespread. A recent writer (13) gives the details of such attacks; the onset is sudden, with frequent vomiting, urgent dyspnoea, pallor, restlessness and a rapid feeble pulse. Recovery is very rare - 17 out of 22 cases died.

The cause of the attack is to be found, it is supposed, in implication of some branches of the vagus.

Pericarditis and Endocarditis are rare complications of diphtheria and when they do arise can rarely be ascribed to the diphtheria.

URINARY SYSTEM:

Albuminuria during the course of the disease has been already considered; its presence is believed not to be indicative of any disease of the kidney but to be analagous to the albuminuria sometimes found in the early stages of other fevers, e.g., Scarlet or Enteric Fever, and which has been called "Febrile Albuminuria".

Nephritis may occur however though it is not very/

very common, Lennox Browne gives the per-centage in his 1000 cases as 2.7 and Goodall and Washbourn found it five times in 1071 cases. In one of the cases of this series there were evidences of nephritis - blood and albumin and casts in the urine - on admission, it was difficult to say whether this was due to the diphtheria or whether it had existed before, but the history, though somewhat indefinite, seemed to indicate that the latter was the correct conclusion.

Anuria is not a common complication but it is a most fatal one and may appear with marked suddenness when the patient seems to be going on satisfactorily.

Death in one of the fatal cases was due to this complication and as it is practically a typical example it might be worth while describing it.

The patient, a girl of three, was admitted on what was believed to be the third day of the disease, the premonitory symptoms being headache, loss of appetite, sickness and vomiting and sore throat.

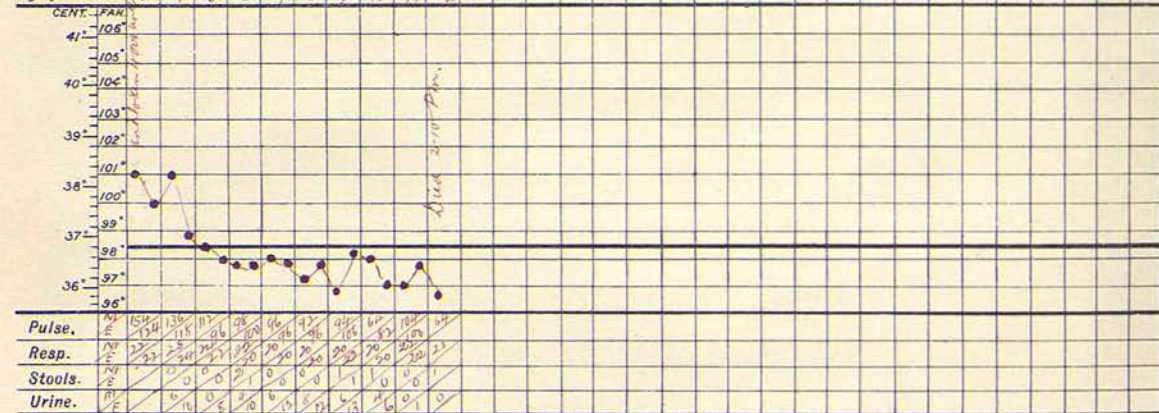
On admission, there was pallor and visible enlargement of the glands on one side of the neck. The tongue was clean and foetor was very marked. There was considerable congestion of the fauces and enlargement of the tonsils, the whole being coated with/

Records of Temperature, Pulse, Respiration, Stools and Urine, from Janet Mowat in case dying from Anuria Day of 18

In the case of Janet Mowat

Aged 3 Occupation Death

Day of Month. 6 7 8 9 10 11 12 13 14 15 Dec. 1900
Day of Disease 3 4 5 6 7 8 9 10 11 12



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with thick membrane fairly easily removed. Temperature 101° F. (see chart), pulse 154 per minute, no albuminuria. The membrane showed typical bacilli. Antitoxine 4000 units was injected; on the spots from which membrane had been removed a fresh layer was laid down in a few hours.

For the first five days the child did very well, the temperature falling to normal by the second morning. The urine this day showed a trace of albumin. By the sixth day the throat was clean and glandular enlargement almost gone, during the night the child had been sick once or twice and she was looking rather pale and in the evening it was noted that the pulse was slightly irregular and that there had been a return of the sickness; the urine showed no albumin.

Next day - the seventh - sickness continued, the pulse was slower, 64, and irregular, but the heart sounds were quite closed and clear. The urine was lessened in amount and contained albumin.

All night there was sickness, the temperature kept subnormal but the pulse became more rapid and distinctly irregular. The urine on this- the eighth^{day,} was passed in very small quantities at a time and was loaded with albumin and showed casts, but/

but no blood. Feeding by rectum was kept up but the child clamoured incessantly for fluid and drank greedily whatever was given to her, nothing however was retained beyond a few minutes.

During the night no urine was passed but after repeated hot packs half an ounce was obtained which showed the same characters as before.

On the ninth day the child died at 2 p.m.; up till this hour she was quite conscious, very restless and pulseless. The eyes were dark-ringed, the pupils dilated and the cry for water and the incessant vomiting continued. All attempts to get her to pass urine were of no avail.

In this condition she continued till just before death when she called out for a drink and drank greedily. Almost immediately afterwards she vomited and with a cry passed into a slight convulsion in which she died.

The notes made at the section, 24 hours later were:- Rigor mortis fairly marked. Child fat and well nourished.

Thorax:- heart soft and dilated, cavities contain some white clot. Valves normal. Left lung adherent all over to chest and diaphragm. Lung slightly congested. Right lung normal.

Abdomen:- Stomach not dilated, no stenosis at either orifice. Contains a small amount of fluid. Mucous membrane slightly inflamed and coated fairly all over with mucus.

Kidney:- Slightly congested. Capsule strips easily.

Bladder:- Empty and firmly contracted to size of a pigeon's egg.

Elsewhere nothing.

All efforts to control the vomiting in this case proved absolutely unavailing, first ice and cold fluids were given and when they failed hot fluids were employed but they were equally useless. Bismuth and antipyrin and Hydrocyanic Acid and Bromide were given but were, like everything else, rejected. Mustard applications to the epigastrium also did no good.

After the first day food and drugs were given by the rectum.

To stimulate the secretion of urine hot packs and applications over the kidneys were tried but with very little success.

The most pitiful features of the case were the intense thirst and the clearness of intellect till the last moment. The vomiting did not seem to be at all distressing fluid merely regurgitating a few seconds or minutes after it was swallowed.

Microscopical examination of the kidney in these cases rarely reveals anything but slight fatty degeneration and sometimes infiltration of the interstitial tissues with leucocytes (Goodall and Washbourn).

HAEMOPOIETIC SYSTEM:

During convalescence enlargement of the glands may take place although this is a much rarer complication than in Scarlet Fever. Suppuration may occur but is not common.

In three of the 100 cases secondary adenitis appeared and in one case the process went on to suppuration.

One patient was a male of 20 who presented no glandular enlargement on admission. The complication appeared during the second week of convalescence, the gland was visibly swollen and somewhat tender but soon settled down under hot applications.

In the case in which suppuration occurred the enlargement did not begin till the third week, it continued to discharge for some time after it was opened but eventually healed up.

SPECIAL SENSES:

Taste and hearing are sometimes interfered with early in the attack and there may be some degree of anosmia as well, these, however, are rarely marked and are usually transient.

Otorrhoea is sometimes found, it appeared once only in the series.

Affections of Vision may occur as a result of ciliary paralysis, but will be referred to later.

NERVOUS SYSTEM:

Of all the sequelae probably those the result of the action of the diphtheria toxine on the nervous system leading to the condition known as Post-Diphtheritic Paralysis, are the best known and possibly also the commonest.

The percentage occurrence is variously stated, Goodall and Washbourn found it in 125 out of 1071 cases - nearly 12%.

Lennox Browne gives it as 14%.

In an analysis of 2093 cases, which were treated in the Boston City Hospital, ⁽¹⁴⁾ paralysis, either palatal or oculo-motor, was found in 91 - just over 4%. This seems fairly low, the figure in the present series being 7%.

It is usually stated that paralysis most commonly appears in the second, third or fourth week but instances are not lacking to show that it may occur earlier even about the fourth day and before the membrane has disappeared, although this is not so common. Also, it may appear much later, in the seventh or even the tenth week after the symptoms have disappeared and when the attack has been forgotten.

In the cases analysed, on the average, the nineteenth/

teenth day was that on which the condition was first noticed, three were in the second week, one in the third and two in the fourth week; in one it was as late as the fifth week before the symptoms showed. The earliest was the eleventh day, the latest the thirty-fifth.

Dr Hector Mackenzie in the paper already mentioned (9) analyses 150 cases and shows that the greatest number appeared in the first three weeks. In one case it was delayed till the tenth week.

It is generally stated that there is a greater tendency to this complication in the young. The majority of the cases - 71% - appeared among children under 10, the remainder were aged from 10 - 20; six of the seven - 85% - were females.

Paralysis may appear after any type of the disease after the mildest cases or after the most severe, occasionally also the occurrence of paralysis may be the first indication that the patient has suffered from diphtheria. Most physicians have seen cases in which the patient denies all knowledge of having had diphtheria or even a sore throat.

It may follow diphtheria affecting any of the mucous membranes or diphtheria of wounds it is, however, /

however, generally believed that it is less frequent after laryngeal than after the faucial form; only in one of the 43 examples of the former type did paralysis show itself and never once has one seen it following cases requiring tracheotomy. Of the 7 faucial cases affected, in one the tonsils only were involved in the diphtheritic process, in the remainder the tonsils and fauces as well showed exudation; in one of the 6 the buccal mucous membrane was affected.

It is sometimes stated that cases with nasal implication very frequently show paralytic sequelae on account of the large absorptive surface, rich in lymphatics and blood vessels, at the disposal of the toxines. In one only of the cases noted above was there distinct evidence of nasal diphtheria.

The parts affected are, the Soft Palate, the Pharyngeal Muscles, the Ciliary Muscles, the External muscles of the Eyeball, the Muscles of the Larynx, the Intercostal Muscles, the Diaphragm, and the Heart; the Muscles of the Head, Trunk and Limbs, and sometimes the muscles of the Face may be involved. The Oesophagus, the bladder and the rectum much more rarely suffer.

of/

Of all these, paralysis affecting the palate and the ciliary muscles is the most commonly seen and usually the palate is the first to be attacked though afterwards spread may take place to other parts. The heart, of course, may be involved alone and probably in all cases dying of heart failure the cause is primarily paralysis of the cardiac nerves.

The first indication of affection of the soft palate may be the discovery of an alteration in the speech, a nasal twang being given to the voice.- In other cases, coughing and spluttering in swallowing food or actual regurgitation of fluids through the nose may first be observed.

On examination the soft palate is found to be motionless and insensitive. It does not move when touched and when the patient phonates, or when he swallows, the nasal is not properly separated from the buccal cavity and escape through the nose, of air in the former case, and of fluid in the latter, is permitted.

Paralysis may be unilateral or bilateral, it may be slight or severe, when slight regurgitation may never occur or only to an inconsiderable extent, when severe it may be very marked, in young children it may be so bad as to prevent suckling.

In/

In five of these cases there was regurgitation but it was never very severe, in the others it was absent.

In some cases paralysis may proceed no further the palate only being involved. When the pharyngeal muscles are affected swallowing becomes more difficult and regurgitation is more likely to occur. Owing to the associated loss of sensibility there is a possibility of the food getting into the larynx. In one case there was distinct difficulty in swallowing due undoubtedly to this affection of the pharynx.

After affecting the palate the process may extend to the ciliary muscles and interfere with the power of accommodation and near vision. These muscles, however, may be first and alone affected.

In one only of the paralysed cases did the ciliary muscles suffer distinctly, this was in a girl of 18 and the difficulty with accommodation did not appear till nearly four weeks after the palatal paralysis, signs of which had then practically vanished.

Another case was interesting, the patient, a boy of ten, with palatal paralysis, discovered that he could not see with the left eye and was suspected of having unilateral ciliary paralysis till an ophthalmoscopic examination revealed the presence of an old choroiditis.

The/

The external muscles of the eyeball may be involved and most usually the external recti although the internal recti or even all the external muscles of one or both eyeballs may be affected.

The levators of the eyelids are less commonly attacked. When the paralysis is widespread the intercostal muscles and the diaphragm may suffer and lead to interference with respiration. If the former are affected alone the breathing is abdominal, in the case of the latter the sinking in of the epigastrium with inspiration will be noted. Dr Hector Mackenzie advises that, in all cases of paralysis, this should be examined for as it is often present in a slight degree and is apt to be overlooked.

It is in these cases that the cardio-pulmonary seizures referred to most commonly occur.

Facial Paralysis may occur and be bilateral or, apparently also, unilateral for Tirard⁽¹⁵⁾ relates a case in which it was present along with paralysis of the palate, diaphragm and external muscles of the eyeball.

The muscles of the head, trunk and limbs, may be affected. In the first case the patient is absolutely unable to move the head or to raise it from/

from the pillow and if the leg muscles are paralysed or those of the arm there is inability to walk in the one case and to use the arms in the other.

In one of the cases the muscles of the neck were involved after paralysis of the palate had lasted nearly three weeks. The child was very limp and if raised from the pillow the head dropped back till it found something to support it. This condition endured for almost a fortnight and then quickly improved.

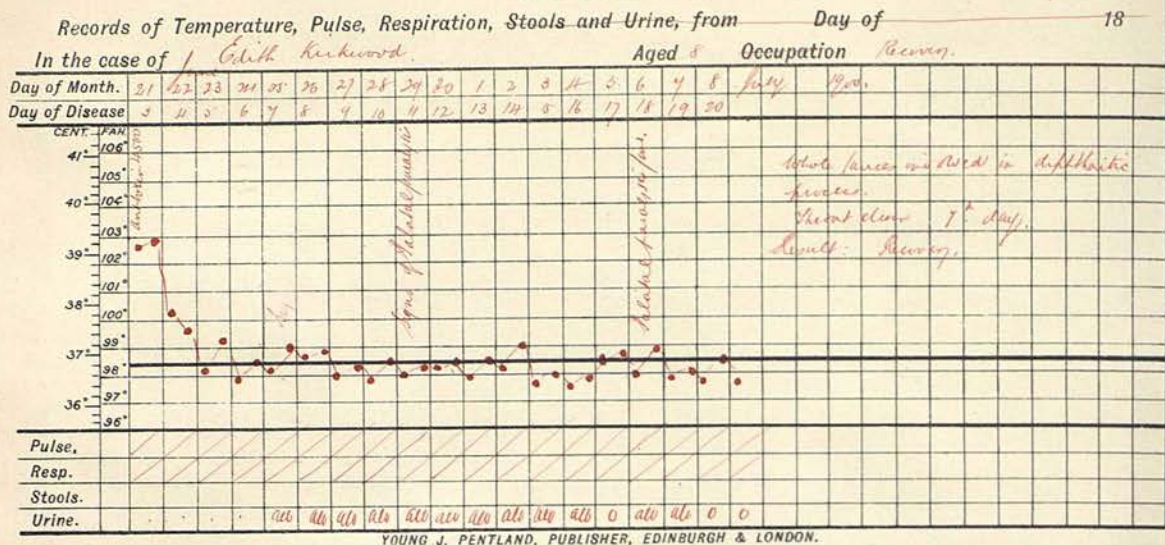
In progressive paralysis the legs are most usually affected before the arms the patient complaining first of weakness, the gait is staggering and later there is complete loss of power the patient being sometimes unable to move the limbs at all even in bed. The deep jerks are lost though it is stated that, before they disappear, there is for a time a distinct increase.

The muscles are flaccid and sometimes painful.

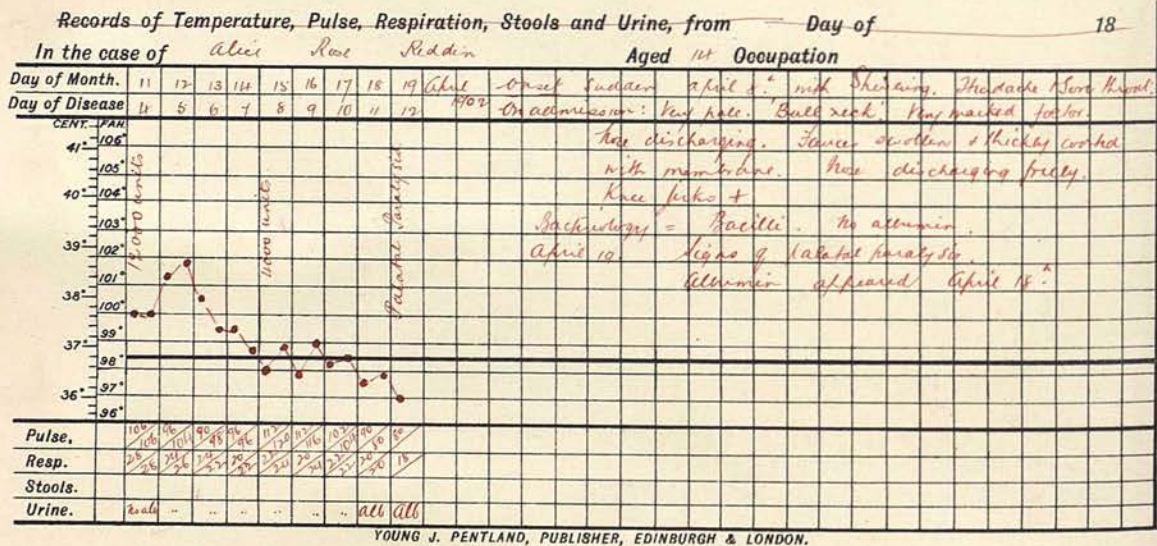
Nearly always after diphtheria there is weakness of the muscles of the leg the gait of the patient being unsteady the foot being brought down as a whole and not bent at all.

In most paralytic cases the weakness of the legs is even more marked the patient walking with difficulty/

To show association between albuminuria & Salatal Disagis.



To show relation of albuminuria to paralysis.



difficulty for some time even though there is no distinct paralysis and the reactions are present.

The arms are less commonly affected than the legs and the muscles most usually involved-according to Tirard - are those in the hand connected with the finer co-ordinate movements. At the same time the paralysis may be so bad that the patient may be unable to raise a cup to the lips.

The trunk muscles are still more rarely affected.

The Relation of paralysis to Albuminuria is interesting, in nearly all cases affected albumin is present, probably because it is most commonly the worst cases which become paralysed and the worst cases usually show albumin. Cases in which the albumin is large in amount and persistent are generally most affected and the paralysis more widely spread. In two only of the seven cases was it absent, in the remaining five it was present in varying amounts.

Formerly this albuminuria was taken as an indication of the uraemic origin of the symptoms but now this idea has been abandoned and it is chiefly taken as a guide in the giving of a prognosis, cases in which it is large in amount always being the most affected.

COURSE, PROGNOSIS AND DIAGNOSIS.

After once having shown itself the paralysis may remain limited to the part first attacked - the palate etc., or it may spread, sometimes quickly, sometimes slowly.

The duration varies from a few days up to weeks or months, the average being 6 - 8 weeks. In the present series the average was four weeks. In one case the palate was first affected but recovery was complete from that in ten days, and four days later cyclical paralysis appeared and endured four weeks.

The intensity of the paralysis varies greatly; in the case of the palate there may be a variation from day to day, one day there may be marked nasalism and the next this may be gone.

In the case already mentioned in which the neck muscles became involved, this variation was very noticeable and after having almost entirely disappeared paralysis of the palate reappeared with the paralysis of the other muscles, and lasted till this latter disappeared.

The prognosis in palatal cases is generally good the main risk being the passage of food into the larynx and the development of septic pneumonia, usually however complete recovery follows.

When/

When the paralysis is wider spread the prognosis is not so good and is worst of all when the respiratory muscles are involved. The possibility of the occurrence of cardio-pulmonary seizures is to be borne in mind and irregularity of pulse and respiration, vomiting, and duskiness, are to be regarded as bad signs.

In paralysis of the limbs recovery, although sometimes tedious, is generally complete.

None of the cases considered died but Goodall and Washbourn put the mortality at 13%.

Diagnosis if the patients are under treatment for diphtheria is generally easy. The first sign of palatal paralysis may be either cough on swallowing or regurgitation through the nose but these may be absent and a slight nasalism, difficult of detection, may be the only sign present for a long time the other symptoms appearing later. The chances of failing to diagnose such a case are considerable and patients may be up and going about with a gradually advancing paralysis upon them or may be discharged from a hospital to develop more marked and even dangerous symptoms outside. One has seen at least one such case. The patient in this instance was a nurse and though there seemed to be some/

some interference with the voice it was very slight and was supposed to be due to a set of false teeth recently fitted. For a fortnight there was no change and she was discharged, 10 days later, however, it became more marked, regurgitation sometimes and occurred after a time accommodation was affected.

In the City Hospital Edinburgh it has been for some years the custom, and it is a custom well worth imitating, to ask the patients, especially if children, to repeat test sentences from time to time, especially before discharge. The test sentences employed are those introduced by Professor Wylie, when he was consulting physician to the hospital, viz., "Billy Button bought a butter biscuit," and "David Doldrum dreamt he drove a dragon"!

In children, especially those too young to read, accommodation may be tested, as recently suggested by asking them to put the point of a pin into a hole in a card.

Paralysis of the diaphragm is to be diagnosed by the loss of voice and the ineffectual cough as well as by the recession of the epigastrium during inspiration, by the increased activity of the chest, and the increased width of the lower part of the thorax and the subcostal angle.

Paralysis/

Paralysis of the lower limbs is diagnosed by the loss of power and absence of the deep jerks. Sometimes the reflexes are increased for some time before the development of paralytic signs but in very severe cases of diphtheria the jerks may be absent from the beginning. Sometimes also the jerks are said to persist all through the attack of paralysis.

In cases not seen till the paralysis has occurred diagnosis is more difficult and the history of a slight sore throat may be the only evidence of a previous diphtheria.

If the palate is affected the probability of the condition being post diphtheritic is greater, but in the case especially of the legs it may be more difficult to be quite certain.

The bilateral character would suggest a toxic origin and Dr Hector Mackenzie suggests that a history of a recent attack of measles may lend support to the possibility of a previous diphtheria, as may the history of Rhinorrhoea.

ASSOCIATED DISEASES:

Diphtheria may be found along with practically any of the infectious group of diseases and may be a sequel of any of them. The disease which one most frequently finds it accompanying is Scarlatina and/

and in six of these cases there was such an association.

In one instance it was in company with chicken-pox.

Typhoid Fever and Measles may sometimes complicate it although it is much more common as a sequel of the latter.

Reference has already been made to the effect of the accompanying disease upon the course of the temperature. The throat symptoms and the glandular affection in these cases associated with Scarlet Fever, as may be imagined, are generally more marked. The appearance of the patient even if the rash be present is more suggestive of diphtheria, languor, and pallor being usually found. If the rash be absent or faint no suspicion of the co-existence of Scarlet Fever may arise till desquamation appears.

As a sequel of Scarlet Fever or of Measles, Diphtheria may be very serious, in some hospitals post-Scarlatinal diphtheria is very well known but in this part of the country post diphtheritic Scarlatina is more dreaded, the susceptibility to infection with Scarlet Fever being very great in patients recovered from diphtheria. For this reason every patient in the diphtheria wards is carefully examined for signs of desquamation.

Of diphtheria as an associate or sequel of measles one has had little experience, occasionally cases are admitted with a history of a recent attack of measles but only once within the last two years has a case under treatment for measles been followed by diphtheria.

Other Diseases: Lobar pneumonia and nephritis were each found once.

PROGNOSIS:

In the whole series of cases laryngeal and faucial there were fifteen deaths, the laryngeal form contributed eight the faucial form seven. All over, the death rate was 10.5%, the rate in laryngeal cases being 18.6% in the others 7%. Of the latter, two died within twelve hours of admission, one within thirty-six hours, all three being malignant cases, and one being complicated by pneumonia. The fourth Malignant case died four days after admission.

Of the remaining three, Scarlet Fever was present in one, nephritis in another and in a third anuria.

The patient in whom nephritis was present really died as a result of this complication as she had practically quite recovered from her diphtheria and it/

it was not till nine weeks after admission when uraemic symptoms appeared that she died.

Of the patients who died all, with two exceptions, were females. Two were in the age period 1 - 5, two were between 5 and 10, one between 10 and 15, one between 20 and 30 and one between 30 and 40 years of age.

The following table shows the age and sex of patients admitted with the percentage mortality at each age period.

Age Period	Admitted		Died		Mortality %	
	Males	Females	Males	Females	Males	Females
1 - 5	15	22	...	2	...	9
5 - 10	14	16	1	1	7.1	6.2
10 - 15	2	7	...	1	...	14.2
15 - 20	2	8	...	...	...	...
20 - 30	5	7	1	...	20	...
30 - 40	...	1	...	1	...	...
over 40	...	1	...	...	...	...
Totals	38	62	2	5		

100

7

In giving a prognosis in almost any of the infectious diseases it might almost be laid down as a rule that it ought to be guarded on account of the risk/

risk of complications.

In Scarlet Fever the risk of nephritis and in Typhoid Fever the risk of haemorrhage and of perforation must continually be kept in view no matter how well the patient may apparently be doing.

In Diphtheria even more than in these the prognosis must be guarded, but it seems likely, judging from the diminution in the death-rate since the introduction of Antitoxine that the chances of recovery are much greater now than formerly, provided the treatment is begun sufficiently early.

The main points to be considered are:-

1. The age of the patient.
2. The type of the disease.
3. Associated diseases.
4. The period at which treatment is begun.
5. The possibility of preventing the occurrence of heart failure, anuria and paralysis.

1. THE AGE OF THE PATIENT:

The majority of the patients in this series were under 10 years of age and more than half of these were under 5; in this period also the great bulk of the deaths occurred the worst time being from 3 - 5.

Between 10 and 20 the disease is less common and less fatal but after this again it is, comparatively/

ively, more frequent and more fatal.

Below two years of age the disease, in the faucial form, was comparatively infrequent and one finds as a general rule that children at this period do well even though it is almost impossible to get them to lie still in bed as is done with older patients suffering from diphtheria of the fauces.

2. THE TYPE OF THE DISEASE is naturally of considerable importance. That the prognosis should be worst in malignant cases is easily understood but the fact that the mildest of cases with very little exudation has its risk as well should never be lost sight of.

In the former type the appearance of the patient, the quantity of membrane and the condition of the pulse have to be taken into account. If the pallor is very marked, the glands greatly enlarged, the pulse small, irregular, and rapid, and the fauces thickly coated with exudation while there is evidence as well of spread to the nose it is almost impossible to suppose the patient can do well. It may happen that, by means of antitoxin and stimulants, the patient can be kept going for several days, still the chances of his dying from sudden/

sudden heart failure are very great, or, having got safely to the second or third week, rapidly spreading paralysis may show and the patient run great risks from that.

Should he ultimately recover, convalescence is slow and weakness marked for weeks or months.

In the milder cases in which the general and local conditions are less marked the prognosis as to recovery is better but in these also heart failure and the development of complications themselves serious have to be considered.

The appearance of the patient helps, pallor and languor and listlessness, if marked, are generally not good signs and may be taken as indicating that the heart is weak. Very often such signs are found. Where the nasal cavities are affected, and these are always anxious cases.

Glandular enlargement also, if great, indicates a severe local affection.

The Quantity of Membrane is not in itself any great guide, though of course it is usual to find that those with an extensive involvement of the fauces do badly, probably because there is a large area for the absorption of toxins which, circulating through the body, may produce complications liable to carry the patient off.

More/

More serious still is any tendency for the membrane to spread rapidly and to reform rapidly after removal. Especially dangerous of course is a spread downwards into the larynx, fortunately however, as has been pointed out by many observers, this rarely or never occurs now-a-days after anti-toxin has been administered.

Mention has already been made of the importance attached by some to the size of the left ventricle as shown by percussion, any displacement of the left border exceeding a finger's breadth outside the nipple line being held to indicate interference with the cardiac nerves, and degeneration and weakening of the muscular tissue, with a grave risk of heart failure unless great care be exercised.

In these cases there are other signs, pallor, listlessness and a rapid soft pulse, to put one on one's guard.

Albuminuria, especially if the quantity of albumin is at all considerable, as an index of the intensity of the poisoning must not be forgotten.

Persistent vomiting is a very serious sign and combined with anuria is a symptom of bad omen.

The importance of absence of knee jerk in diagnosis has been referred to, but its value as a prognostic/

nostic sign is, according to Dr Hector Mackenzie, much greater; he himself failed to find the reflex in no less than 30% of his fatal cases.

3. ASSOCIATED DISEASES:

These must be regarded as influencing the prognosis unfavourably especially if they themselves have a profound effect on the patient's general condition. Six of the present series were associated with Scarlatina and one died. In one case pneumonia was present and in another nephritis and these both died.

With regard to the fourth factor, viz., the period at which treatment is begun, it is obvious that the earlier the fight against the process is started and the sooner the action of the toxine is counteracted the better it will be for the patient. This subject and the next, i.e., the possibility of preventing the development of complications, will be better considered under treatment.

To sum up, it may be said that,

1. Between the ages of 5 and 40, the patient has at least age in his favour.
2. The malignant type of the disease is practically always fatal.
3. Marked glandular enlargement and swelling of the fauces, with a great quantity of membrane, with foetor and a tendency to spread and reform rapidly, are bad signs.

4. Involvement of the nasal mucous membrane adds to the risks.
5. Pallor, and languor with irregularity and rapidity of the pulse indicate that the diphtheria toxine is having a distinct effect on the general condition and that there is danger. Enlargement of the left ventricle and absence of the knee jerk probably indicate the same thing.
6. Albuminuria to any extent is also an indication of severity of affection.
7. Prognosis in the mildest cases mainly depends upon the care which can be exercised, and the treatment adopted.

In giving a prognosis all the signs and symptoms must be passed in review and, even although it is felt that these are favourable, it is well to indicate that there are complications to be dreaded, though they are lessened by care and treatment.

PROTECTION:

The immunity conferred by a previous attack of the disease may last a life time or it may only last for a very short period, in any case it would appear that, in Diphtheria, it is less than in practically any of the other infections. Indeed there are those who hold that one attack predisposes to another but perhaps this is going rather far, although relapses, second; third, and even fourth attacks do occur.

One of the cases in the series developed the disease for a second time a year after the first and one has frequently seen patients admitted for treatment who had suffered from diphtheria before.

It is not uncommon for nurses to be affected oftener than once, Lennox Browne in his essay (p. 120) describes the case of a nurse who was admitted to hospital suffering from a fourth attack and who developed paralysis for a second time and this present collection contains an almost similar example. This patient, the sister in charge of the diphtheria wards in the Leith Fever Hospital, had her first attack of diphtheria in the summer of 1899, two years later, engaged in nursing diphtheria, she developed the disease again. The third attack occurred the year after and preceded the fourth by exactly four months. None of the attacks have been especially severe but convalescence was slower after the fourth than after any of the others. There have been no paralytic or other sequelae. Anti-toxin has been administered on each occasion and between the third and fourth attacks she had preventive injections of 500 units every month. Owing to some misunderstanding however the last monthly injection was not given and a week after it was due the symptoms appeared, possibly as a result of the omission.

The/

The immunity produced by antitoxine will be referred to later.

TREATMENT:

Before the organismal origin of the disease was fully recognised treatment was in the main local the constitutional measures taking a very secondary place.

Practically all the remedies employed were of the nature of escharotics and had for their object the destruction of the membrane. Speaking, in his second memoir, of the agents then in use Bretonneau says that: "Even the multitude of the measures to which we have had recourse, only proves, too fully, the insufficiency of the greater number of them."

It was mainly in the matter of local applications that there was at this time difference of opinion some practitioners preferring one substance on account of its power of destroying the membrane, others another. The agents employed included, Silver Nitrate, Hydrochloric Acid, Alum, Ammonia, Sulphuric Acid, Calomel and many others; most of these Bretonneau himself used but praised especially Alum and Hydrochloric Acid which latter he used first mixed with honey and then later pure and/

and concentrated with the idea that by substituting another inflammation for the specific one the progress of the latter would be stopped.

This form of treatment continued to be the vogue for many years now one now another membrane destroyer being in favour, the publication of a wonderful cure by one agent bringing it into prominence till results, equally remarkable, were produced by something else.

When the idea that the disease was the result of bacterial action began to be admitted and anti-septics were coming into use for other purposes, caustics and escharotics made way for what seemed to be a more scientific treatment and with the discovery of the specific germ this became the only treatment.

At one time and another there arose much discussion as to what should be done with the membrane, whether it should be left to separate by itself - assisted by the various applications - or whether it should be torn off.

By those who adhered to the former view endeavour was made to discover a substance which would have a solvent effect upon the exudation.

The agents used were Lactic Acid, Lime Water, Chlorate of Potash, Salt Water, Resorcine, Papaine, etc. and each had its advocates although the first mentioned/

mentioned gained most favour and was most recently in use. Indeed in Lennox Browne's book so frequently referred to here and published so recently as 1896, a description is given of some experiments which he performed to determine which was the best solvent, lactic acid being found by far the most valuable for that purpose.

Those objecting to the removal of the membrane did so firstly, because they held that the disease was more than a local one, and that the germs had got into the circulation before the membrane could be removed. Secondly, they believed that absolute harm might be done, the mucous membrane injured and with its vitality lowered, being an excellent nidus for the diphtheria bacillus.

Those who held the opposite view contended that the disease was primarily local the general symptoms being due to chemical poisoning. They advised that the membrane should be removed and a caustic or a strong antiseptic applied.

Between these were many who, though they did not believe in forcible removal, thought that gentle friction would do no harm and might remove a considerable amount of the exudation and let the substances applied get at the tissues better. To this/

this last group Lennox Browne belonged and he advised that the finger swathed in lint soaked in lactic acid or the applicator bearing the swab with which the lactic acid was to be applied should be rubbed fairly firmly over the part so as to detach the membrane at the edge.

The antiseptics used were Carbolic Acid, Potassium Permanganate, Hypochlorite of Soda, Sulphurous Acid, Corrosive Sublimate, Boric Acid, Peroxide of Hydrogen, Chlorine water, etc. These were applied either as sprays or gargles or more directly by means of a swab. Syringing was also in some cases employed.

Various powders, e.g., Calomel and Sulphur were also employed being blown through a small tube upon the affected part after the membrane was removed.

Dissatisfied with the action of antiseptics in general Löffler made a series of experiments to find exactly their effect upon the diphtheria bacillus. Most of those in common use, e.g., corrosive sublimate, chlorine, etc. took at least 20 seconds to kill the organism. In many cases application for 20 seconds was out of the question and by careful observation he discovered that the strong perchloride of iron could produce a similar result in 10 seconds. Toluol he found interfered also/

also with the development of the germ, so that he advised a mixture of these and, to diminish the pain, suggested that menthol should be added.

From personal experience one can vouch for the excellence of this application in various forms of sore throat but it has its objections.

Several modifications in its constitution have crept in but the method of applying it remains the same, a swab dipped in the fluid being applied to the affected part for ten seconds no friction at all being used. Considerable care has to be exercised in making the application as it is somewhat irritating and this is its chief objection.

The formula generally employed is as follows:-

Liquor Ferri Perchloridi Fortior	4 c.c.
Menthol	10 grms.
Toluol	36 c.c.
Absolute Alcohol	60 c.c.

ANTITOXIN TREATMENT:

With the discovery of antitoxin came further changes in the treatment, that the disease was to a very great extent constitutional was generally recognised and as the effect of the serum in limiting the spread of the membrane was noted, the importance attached to energetic local treatment began to diminish.

Though/

Though there are still many who doubt the value of the antitoxic treatment those who, as a result of experience, have a right to speak have absolute faith in it.

The writer's own personal experience though not perhaps large is still considerable and goes back to 1897 when antitoxin was beginning to take its place at the top of the list of curative agents.

At that time local treatment was combined with the antitoxine treatment the toxine being attacked by the antitoxin and the organisms in the membrane and about the fauces by the application of substances like Boric Acid in Glycerine or Löffler's solution or by gargling or syringing with some antiseptic solution, permanganate of potash, peroxide of hydrogen, or one or other of the advertised "disinfectants", Listerine or Sanitas. The quantity of antitoxin injected was small, from 1500 - 3000 units, rarely more, except in laryngeal cases, this partly because that was the dosage recommended at the time and partly because of the cost of the serum.

With time and experience came greater faith, the serum so obviously doing good; the patient felt better, the throat looked cleaner, the membrane ceased to spread and separated more quickly and as
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a result injections were given more promptly and in larger doses, especially in hospital practice.

After becoming acquainted with the power of the antitoxine and after using it for about three years one determined to drop topical treatment as a routine altogether and for the last two years, with very few exceptions, no local applications whatever have been made to the throat, the treatment being purely an antitoxine one stimulants or heart tonics being given if necessary. The exceptional cases were those in which there was discomfort from swelling and enlargement of the tonsils and fauces and in these cases syringing or gargling was permitted, but stronger applications like Löffler's solution were practically never used.

One was lead to do this by several circumstances, firstly, especially in children, there was always much struggling and kicking during the process which seemed capable of doing a certain amount of harm by throwing a strain on the heart; secondly, in private practice, and even in hospital, a great deal of the antiseptic did not reach the part affected, and thirdly, improvement followed in laryngeal cases with no local treatment whatever.

In cases in which there is marked nasal involvement/

volvement, although even the discharge in these dries up in a very remarkable manner with nothing else but antitoxine, one generally employs syringing with weak corrosive lotion or sanitas and the patient derives a great deal of comfort from this. Incidentally it may be mentioned that, had the serum nothing else to recommend it, its power of drying up nasal discharge the result of diphtheria would be quite sufficient to make its claim for recognition a very strong one.

In connection with the administration of antitoxine physicians vary very little, but one naturally has followed the method taught in the Edinburgh City Hospital and the routine procedure is as follows:- On admission the patient is at once prepared for antitoxine the abdomen being generally chosen as the site of injection, partly because it is easier to get at and partly because the patient does not lie upon it. So far as one can gather also it is less painful here than between the scapulae.

The whole abdomen is washed well with soap and water, then with turpentine and next with methylated spirit, after which a compress of Carbolic acid 1 - 60 or 80 or of Lysol 1 - 100 or 120 is applied./

applied. The syringe is boiled and with it a few pieces of lint for application after the injection has been given.

The quantity of serum administered depends entirely on the type of case, practically no attention being paid to the age of the patient. The dose is rarely less than 4000 units, where the faucial involvement is considerable 8000, 10000, 12000 or more units may be injected, the whole dose being given at once and not spread over several days as is the case in some places. On the average mild cases receive 4000, the malignant cases 7000 units, although of late one has been giving the latter much larger doses, 12000 at least.

After the injection the lint is applied over the seat of injection and the whole covered up with a bandage or binder.

The day after the injection improvement is generally noticed, the temperature has fallen, inflammation is less, the membrane if it is not visibly diminished has at all events ceased to spread and from this onward the patient continues to get better. On the second day there is marked diminution in the amount of exudate and by the third, fourth or fifth day it is completely gone. It/

It may take longer in some cases, the time depending upon the day on which treatment was begun.

With the improvement in the throat symptoms goes diminution in the glandular enlargement and improvement in the general condition.

On the average - excluding the cases dying before there was time for the antitoxin to act - the throat was clean by the fourth day, though in some it was clean on the second and in others not till the eighth day after injection.

GENERAL MANAGEMENT:

Apart from antitoxin what is aimed at in these cases is to keep up the patients' strength and to preserve him, as far as possible, from the risk of heart failure.

When admitted he is put to bed and kept there, on the average, for three weeks. If an adult he is warned against making any sudden movements and if a child the head is kept perfectly flat upon the mattress no pillow being allowed, there being less tendency to sit up when the head is kept at this level.

The patient is practically allowed to do nothing for himself and the nurse is made aware of the dangers and instructed to watch the patient carefully.

For/

For the first day or two the diet is mainly a fluid one - milk and beef tea or chicken tea - but, as soon as possible, bread and milk, soup, fish and so on are added, the patient by the end of the first week being on a light though full diet. Practically no attention is paid to the albuminuria.

So far as drugs are concerned there is no routine; the pulse is carefully watched, any sign of weakness or slowness or irregularity being met by the administration of alcohol in small quantities or of strychnine or both. The value of alcohol in diphtheria is recognised practically by all and one never hesitates about employing it as one might do in Scarlet Fever. It has been suggested by Dr Sims Woodhead (?) - that because toxins are readily soluble in alcohol the administration of this substance in cases of diphtheria by dissolving these bodies and making them more easy of absorption is prejudicial to the patient but, clinically, proof of this is wanting and it is much more frequently found that good follows the use of good whisky or brandy. The former is generally chosen and the dose given - even to adults - rarely exceeds $\overline{3}\text{v}$ in the 24 hours, and for children usually $\overline{3}\text{ii}$ - $\overline{3}\text{iii}$ suffices.

Strophanthus or Digitalis are less commonly employed.

For/

For the bowels, if a purgative is required, one prefers to use small doses of Castor oil or Syrup of Senna as being the most gentle.

In the second week the patient is allowed to have a pillow and if doing well in the third week a second is added. For the first three or four days of the fourth week he is allowed to sit up in bed at meal times, during the next three days he gets up in blankets for an hour or two in the afternoon and at the end of this time he is allowed to have his clothes on and to walk about for a little.

Convalescence is, as a rule, slow but generally by the end of another fortnight he is fairly strong and able to go about. During this time tonics of iron or iron and quinine are sometimes given or one or other of the tonic syrups, preferably the Syrupus Ferri Iodidi, more usually however the main trust is in feeding and fresh air.

During the whole course of the illness careful nursing and watchfulness are required, especially in the night time. It is remarkable how often, in children with diphtheria, the temperature falls below normal in the early morning hours and the pulse becomes poor and slow or irregular. A good nurse is one who is continually going round her patients/

patients watching for variations in the pulse and for any sign of cold feet. Always one allows the nurse to use her discretion as to the administration of hot drinks and small doses of alcohol in the night and she is of course expected to put hot bottles to the feet if required.

TREATMENT OF COMPLICATIONS AND SEQUELAE:

Persistent vomiting whether or not associated with anuria requires careful treatment although, too often, all efforts to stop it are in vain. In the case one had under treatment which was associated with anuria, fluids were given at first cold and then later hot but the stomach retained nothing and feeding by rectum had to be resorted to. Drugs had no effect, Bismuth, Antipyrin, Potassium Bromide and Hydrocyanic Acid were all tried but without success.

In any case, with vomiting it is not safe to delay and efforts should be made to stop it by sedatives, and rectal feeding should be begun early.

Cardiac Complications must be prevented as far as possible by lightening the heart's work, keeping the patient in the recumbent position and forbidding any sudden straining and movements.

Tachycardia/

Tachycardia and Bradycardia are exceedingly difficult to treat and may persist for a long time even with tonics and so on. In both, rest is the primary indication, and in the former one has tried digitalis and strophanthus but strychnine is preferable the dose being gradually increased; in the latter besides strychnine, whisky, aromatic spirits of ammonia, ether and liquor trinitrini are generally given.

In all forms of Paralysis the patient is at once put upon strychnine 1 or 2 minims, to begin with, every four hours but gradually increased.

In all cases also the patient should be kept in bed and recumbent, if after two or three weeks there seems to be no tendency to spread he may be allowed to sit up in bed for a short time daily and later may be allowed to get up for a little each afternoon in blankets.

If the paralysis, even if confined to the palate, is at all marked, with a tendency to regurgitation, one prefers to be more strict and to keep him lying down till there are signs of improvement. When the muscles of the neck are involved the patient does not try to sit up.

When the diaphragm is involved the lower end of the bed should be elevated.

When/

When the legs are affected the same treatment may be adopted as in the case of palatal paralysis, viz., rest and strychnine.

The feeding in palatal paralysis must be carefully attended to and one usually insists upon the nurse carrying it out by means of a feeder or a spoon. In bad cases a nasal tube may have to be used or rectal feeding employed; in the former case it is advised that a pause be made after passing the tube to make certain that it has not gone into the larynx.

In none of the cases included here was it necessary to resort to these means, but great caution was always employed, fluids and soft solids like pudding, potatoes mashed in gravy, and bread and milk only being used till there was definite improvement in the swallowing powers.

In the later stages of the paralysis electricity seems sometimes to hasten recovery slightly, especially if combined with massage of the muscles wherever possible. Indeed it is probable that in no form of paralysis is massage so successful as in this post-diphtheritic form and all cases of diphtheria are the better for it the patient picking up very quickly under it.

The treatment of anuria is difficult, hot packs/

packs and hot applications over the loins must be persevered in, with digitalis and strophanthin hypodermically.

For the glandular enlargement one uses hot applications followed after a time by a collar of Gamgee tissue and when suppuration occurs an incision is indicated.

Otorrhoea calls for syringing with boric lotion.

The effect of treatment on the Prognosis.

Apart altogether from the use of antitoxin it seems likely that, by getting the patient as early as possible under observation and careful nursing, the better will be his chances both as regards recovery and the prevention of complications.

It cannot be doubted that by enforcing rest there will be less risk of heart failure and in the same way rest of other parts of the body may diminish somewhat the tendency to paralysis.

One objection offered at first to the use of antitoxin was that it did not seem to prevent the development of paralysis and other complications but the explanation offered by Goodall and Washbourn (p. 165 and Appendix IV.) that this might be due to the fact that under its use more severe cases recover than formerly and it is in these mainly that paralysis occurs, seems quite a good suggestion.

That/

That there are still some who refuse to use antitoxine, for one reason or another, one finds every day and at least once one has heard antitoxin blamed for causing a death obviously due to heart failure. Possibly the serum was, in this instance, partly to blame, because the patient recovered so rapidly that he was allowed to get up at the end of a week.

The expense of the serum is in many instances a consideration but after all half-a-crown or three shillings per 2000 units is not exorbitant. Where the circumstances of the patient will not permit of its purchase however it is clearly the duty of the medical attendant to use his influence and to insist upon having the patient removed to hospital. Some local authorities here but more especially in America supply antitoxine free but in all cases removal to hospital is preferable in every way.

That the antitoxin treatment should be begun at the earliest possible opportunity is admitted by all, and it is only necessary to study the statistics prepared by the committee of the Metropolitan Asylums Board and others showing the effects of early injection and the higher mortality amongst those from whom the remedy has been withheld till a later period, to be convinced of this fact.

Thresh/

Thresh⁽¹⁷⁾ quoting the statistics of the Chicago Board of Health gives the records of 5727 cases treated with antitoxin which very clearly show the dangers of delay.

Among those injected on the

1st day	the mortality	was	0.42%
2nd	"	"	1.54%
3rd	"	"	3.59%
4th	"	"	11.38%
after the 4th	"	"	over 23%.

Practically the same information is obtained from the series under consideration. No cases were admitted on the first day of illness.

Of

26	admitted on the 2nd day	none died,	mortality	0
35	" " " 3rd	1	"	2.8%
31	" " " 4th	3	"	9.7%
8	" after the 4th	3	"	37.5%

The claim that the death rate has gone down since the introduction of the serum treatment is fairly generally conceded now-a-days the average case mortality in pre-antitoxin days ranging somewhere between 30 and 40% whereas since the antitoxin passed into general use the figure has rarely reached 20% and is much more commonly 12% - 14%. In Chicago the reduction during the five years 1896 - 1901 has been equal to 80%, the average mortality in pre-antitoxin days being 35% that since 7%.

In/

In the Semaine Médicale for December 11th 1901 appears an article by Dr de Maurans the editor-in-chief discussing the question whether the diminution in the death rate is entirely due to the use of antitoxin. He has obtained returns of the number of deaths from diphtheria in 32 of the large towns of Europe for some years before and after the introduction of antitoxin and has prepared charts showing the curve produced in each case. The curves show, as he points out, that the death rate is continually varying from year to year now increasing now diminishing but in the majority of instances there has been at one time a continuous rise and at another a continuous fall, in the number of deaths, during several consecutive years.

In nearly every chart shown such rises and falls appear and he believes that the rises are due to epidemic waves of the disease and that then the disease settles down again, the number of deaths continuing to be much less for some years. It is remarkable that in a majority of the towns he includes that the fall should commence first when antitoxin was introduced. This he regards merely as a coincidence though he admits that it might quite well be taken as a proof of the value of antitoxin.

While/

While admitting that his argument is weakened by the fact that only the deaths and not the proportion of deaths to cases is taken Dr de Maurans thinks that it does not really make very much difference and instances Paris and Prague in support.

He does not at all doubt the value of antitoxin and willingly admits it is by far the best treatment for diphtheria but thinks it is better not to claim too much for it. He believes that time will show that there will be more of these sudden increases in mortality with the consecutive falls despite antitoxin.

That there are these epidemics one is willing to believe and as analogy we have the epidemic years of Measles and Scarlet Fever which are so well known.

Further epidemics will doubtless occur but even the most ardent supporter of antitoxin does not claim for it the power of preventing epidemics.

Antitoxin has proved its value and an agent which can reduce a death rate, more especially in cases after tracheotomy, as antitoxin has done, is worthy of all trust.

It/

It is in Fever Hospitals the best information is to be obtained and physicians there admit that since its introduction spread of membrane from the fauces to the larynx after admission and injection is practically unknown.

IMMUNIZING INJECTIONS OF ANTITOXIN :

The subject in connection with diphtheria which is at present being discussed and at which a great amount of work is being done is the possibility of preventing the occurrence of the disease in those exposed to it, by injecting antitoxin..

In America, where, so far as one can make out, the belief in antitoxin is unbounded, and partly also in this country serum is supplied free by the local authority and injections are given to those who have been in contact with a person notified as suffering from diphtheria.

From time to time articles have appeared in the various medical journals giving the results in various epidemics of such preventive injections and the general conclusion arrived at seems to be that the method is of value and that protection, lasting for, on an average, three weeks or a month, is afforded.

Dr/

Dr Thresh in a paper already quoted⁽¹⁷⁾ on "Antitoxin and its Uses" relates his experiences and gives at the same time some American statistics showing that, since the introduction of this method of prophylaxis, instead of from 10 - 30% of exposed persons contracting the disease, as formerly, only $\frac{1}{4}$ - $\frac{1}{2}$ per cent. have done so.

In New York during the five years 1895 - 1900 immunizing injections were given to 6806 persons of whom only 18 developed the disease and that in a mild form, one patient died the disease, however, being complicated with Scarlet Fever.

As a comparison it is stated that in 1898 and 1899 there were 682 exposed persons who were not injected and of these 61 died, a mortality of 8.9 per cent.

In Chicago and other places similar results were obtained. Thresh's own experience is of 226 persons, of these 7 were later notified as suffering from diphtheria one, one day after injection, one, two days after, two, three days after and one, five days after, these he thinks may have been incubating the disease at the time of injection. Of the remaining two, the disease in one case appeared 30 days, and in the other 52 days, after/

after injection. He has also a record of 160 untreated persons and of these 35 were notified later. Among those injected the percentage of attack was 3.1, among those untreated 22%.

The amount of antitoxin recommended for the purpose is 500 units or more.

In a hospital one gets very little opportunity of testing the value of antitoxin in this way. Wherever possible all cases in which the accuracy of the diagnosis is doubted are, on admission, isolated, but if not they are injected and put into the general diphtheria ward. Only once has one seen such a case develop the disease and that was a child of 2 sent in with a mistaken diagnosis of "croup" who, in spite of 4000 units injected at once, developed diphtheria of the fauces exactly 21 days later.

Nurses sometimes also are injected but unfortunately no record of the number has been kept, one only, the sister in the diphtheria wards already mentioned as having had the disease four times, obtained no protection.

OBJECTIONS TO THE USE OF ANTITOXIN:

Some conditions following antitoxin are due to the serum others, as the death from heart failure mentioned above, are not.

Conditions/

Conditions which can be traced to it are Rashes, Joint pains and possibly also Albuminuria. Abscesses may also form at the seat of injection.

As regards rashes much depends upon the serum used some makes being more apt to produce such manifestations than others. The rashes are generally of the nature of erythemata or urticariae, they rarely last longer than two or three days but may, as a result of itchiness, give rise to some discomfort.

Usually they appear first at or near the seat of injection but may appear elsewhere, they generally spread rapidly and vary in intensity coming and going till they finally disappear.

Sometimes they resemble the rash of measles or of Scarlatina and if associated with a rise of temperature there may be some difficulty in diagnosing them from these diseases. The fact that the rash appears first and is best marked near the seat of injection should be borne in mind. It is to be noted however that as the eyes are sometimes suffused the resemblance to measles may be considerable.

A search might be made for Koplik's spots to exclude measles, and the absence of the strawberry tongue/

tongue and the congested fauces would help to distinguish the condition from Scarlet Fever.

The rash may appear at any time up to three weeks or more and is apparently as likely to be produced by a dose of 2000 units as by one larger.

Of the present series only five developed a rash on the 10th, 11th, 12th, 15th and 28th days respectively.

Joint pains were much more common in the early days of the serum than they are now and one has rarely met with an example and the same may be said of albuminuria.

Once only has one had an abscess following the injection and that was in a child very marasmic and wasted and suffering from a chronic otorrhoea.

It has been stated that such abscesses are slow to heal but in this case recovery was complete within 10 days of free incision and drainage.

A great difficulty with many is to know what should be done with regard to antitoxin in a case where the diagnosis is doubtful. Should the injection be put off till the diagnosis is made certain by bacteriology or otherwise, or should the patient be injected at once?

Personally, one injects always on the strength of/
of/

of the clinical diagnosis and in most hospitals this is the case. In a doubtful case the patient should always be given the benefit of the doubt and have a dose of serum, there is no danger from it and, strange as it may seem, other forms of angina appear to derive benefit from it. At the same time, if possible, an endeavour may be made to keep the patient apart and a provisional diagnosis can be given till bacteriology or further observation has cleared away the doubts.

CONCLUSION:

In connection with the diagnosis of laryngeal diphtheria and of faucial diphtheria one has already fairly distinctly stated the belief that by careful attention to the clinical features a diagnosis comparatively accurate may be arrived at, but all the signs and all the symptoms must be taken into account, and the tendency to be carried away by the discovery of obstructed breathing and a "croupy" cough, in the former case, and an exudation about the fauces, in the latter case, must be avoided.

Bacteriology is of assistance but errors may occur with it as well, and personally one has never felt that the failure to find diphtheria bacilli in
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a swab was quite so conclusive as the failure to find Widal's reaction in a suspected case of Typhoid Fever.

The writer's experience is of course small but the more one sees the more one agrees with the conclusion of Variot⁽¹⁸⁾ whose words may be set down as the concluding ones of this essay:

"L'examen clinique dans la diphtérie conserve une incontestable supériorité sur l'examen bactériologique parce qu'il est plus rapide en general, plus simple et parce qu'il donne des indications plus exactes et plus complètes."

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